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ABSTRACT

This book is a compilation of 145 conference papers and presentations on industrial arts education covering content in career education, classroom projects, construction, curriculum, elementary school industrial arts, energy, funding programs, graphic communications, interdisciplinary studies, international perspective, past-present-future, metrics, miscellaneous instruction, the professional teacher, research, safety, special needs programs, teacher education, teaching methods, tools, and women. Representative titles include the following: Industrial Arts and the Career Choice Patterns of Junior High School Students, Contemporary Construction Education and Practice, Developing a Leadership and Group Interaction Skills Curriculum, A Continuum of Objectives: The Way to More Systematic Instruction, Industrial Arts Resource Kits for K-6 Grades, The Urgency of Energy Education, Status of Funding in Idaho, An Overview of New and Future Technclogy in the Graphic Communications, Strategies for Unified Arts: A Framework for Analysis, A Rationale for International Technological Education, Crossroads--The Aircraft Construction Route to Aerospace Education, Toward the Year 2000--Futuristics, Industrial Arts in the Industrial and Postindustrial Society, Freedom and Professionalism and Our National Heritage, Industrial Arts Research: Basic Considerations, Wood Surface Noise Control, Industrial Arts in Special Education, Minicourses in Industrial Education, A Competency-Based Teacher Education Program: Graphic Arts, Computer-Assisted Instruction: A Student/Machine Interactive System, and Numerical Controlled Equipment. Conference minutes and resolutions are also included. (EM)

CROSSROADS '76

Addresses and Proceedings of the 38th National and 5th International Annual Conference of the American Industrial Arts Association, Des Moines, Iowa, April 19-23, 1976

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Table of Contents

AIAA General Sessions

Industrial Arts: A Focus on Society's Need

Robert S. Swanson

We are just at the beginning of our nation's bicentennial celebration. The theme of this convention is a bicentennial theme, exhorting us to look at where we have been and where we might go. Besides providing an opportunity to review 200 years of progress in this country and 100 years of progress in industrial arts, this anniversary year of our country provides an opportunity to reflect on the individuals who contributed to that progress. One of those individuals was Benjamin Franklin. To industrial arts educators he should be a hero. At times it seems we have neglected the importance of inventions and inventors on the development of American culture. The plow, the reaper, the cotton gin, the steamboat, the telegraph and later the combustion engine, the airplane, computers, and rocketry were inventions that merit our attention. Some people cite the mass production of automobiles in 1914 by Henry Ford as the real American Revolution.

One of the first American geniuses devoted to mechanical pursuits was Benjamin Franklin. He was an inventor, craftsman and scientist. His printing business provided him with the financial opportunity to sharpen his skills as a writer, diplomat and philosopher. From his humble beginnings as a printer's apprentice, he went on to make world famous discoveries in electricity; he invented the lightning rod, developed his own printing press, made significant contributions relating to heat that led to the development of the Franklin stove (which is reappearing today), invented an electrostatic generator and laid out practical plans for paving and lighting streets. He found time to organize the first fire stations and libraries as well as starting a hospital, an insurance company and a college, now the University of Pennsylvania.

Ben Franklin was a man interested in technical as well as social progress, and he was one of our most prolific givers of good advice. Franklin suggested that if we do not know something, we should admit it. He usually learned something, he said, after he acknowledged his own ignorance. To paraphrase Franklin: Those who think they know everything and undertake to explain everything, often remain ignorant of the many things others could teach them.

This has come to be a prestigious convention, a high point in our annual professional activities. It is not a place where anyone will attempt to explain everything, but it is a place where many will teach something. Let me hope to be among them — the teachers of something.

Industrial arts must consider its place in an environment which has changed in the past decade. Undoubtedly, there are teachers, courses, and whole curricula which operate as though no change had taken place, and there are those who think the changes are only temporary and that we are in the process of returning to the good old days. Some yearn for a "return to basics," but there is no agreement on what the basics are.

What factors in this environment are of concern to us in industrial arts? Certainly there are many, but let me comment on three: Accelerating technological advance, increasing social problems, and reappraising many personal values.

Accelerating technological advances are all around us. There are mechanical spare parts for the human body, homes using solar energy, biomedical monitoring systems, instant and frozen foods, synthetic fabrics and teaching machines.

Technologically we are looking ahead to developments that include ocean farming, personal portable telephones, three-dimensional television in our livingrooms, a permanent base on the moon and robots that perform household chores.

In the printing industry, type is now set through optical scanners; pages are edited at video display terminals; and laser beams are used to separate colored photographs. The industry is printing on new papers made from synthetic fibers. In a sense, printing

has moved from a primary emphasis on the mechanical to an emphasis on chemistry, electronics and physics.

Microminiaturization has revolutionized the field of electronics. With the help of integrated circuits, we now use hand-held calculators and miniature cameras. We have created smaller and more reliable radio and television sets. Microelectronics have found their way into today's automobile and will be used to monitor fuel and emissions.

Miniaturized electronic circuitry will help eliminate 5 miles of wiring in automobiles. Less costly doodads that include window wipers that react to the moisture in the air, automatic light dimmers, and seat and window controls will be affordable.

New materials are being discovered, and we are learning to work with them. We find that they have greater chemical stability, have better moldability and are high in temperature resistance.

In line with developing materials, our university has introduced courses in industrial ceramics. It certainly is not a new material, but it is becoming more important all the time. For example, parts made from ceramics are used in gas turbines. Ceramic parts substituted for metal parts operate at higher temperatures, thus enabling us to gain greater efficiency in fuel combustion.

Wood preservatives have opened up new developments in the home building industry. Homes can now be constructed with wood foundations. They are cheaper, take one-sixth the time to construct, and can be erected in any weather.

Numerically controlled machines are moving parts down assembly lines, picking them up, placing them on circuit boards and soldering terminals. General Motors is using numerically controlled machines to assemble automobile engines.

Biological and medical breakthroughs that have been forecast will test our religious and moral values severely. We are told there will be laboratory creation of new types of life forms, hibernation of people, chemical control of the aging process and new behavior manipulation techniques.

These are just a few of the projected developments, a mere sprinkling of the forecasts. In light of them, widely accepted values must be weighed and reexamined daily.

We are now in a period of transition. We are puzzled by the meaning of or disagree on the value of such concepts as privacy, freedom, patriotism, hard work, loyalty and family.

For months our society witnessed a national drama, a national moral struggle, if you will, revolving around a court case in Morristown, N.J. Medical technological progress of recent years was questioned there—held up before the nation for examination. The court had been asked to decide whether a 21-year-old woman should be permitted to live or die — whether she could be removed from the life support systems that maintain her. Is it morally right to maintain life indefinitely through artificial means? The incident is a sign of the times, just one more piece in our changing mosaic.

The events of our time have forced us to search out the answers through a somewhat painful self-examination process. Vietnam, for instance, forced us to ask ourselves whether we are infallible as a nation, even more painful, whether we are a violent nation. Are we rich industrially, but impoverished when it comes to important social concerns? Are we ready to agree that progress, for its own sake or for economic gain, may no longer be totally acceptable? There are many who are questioning the profit motive. Can business actions which impinge on the public interest be justified?

Recently one of the world's great historians, Arnold Toynbee, died. He gained his eminent reputation by describing the rise and fall of civilizations. His idea was that civilizations rise, develop and decay, usually because they make wrong responses to challenges facing them. Upheaval follows and then the patterns begin again. Rome rose, then fell. Not too long ago Spain was the richest and most powerful nation on earth. After that, France and England were richest and most powerful. Historically we know that Syria, Egypt and Greece were once the brightest stars in the world's lineup of countries.

A British writer and prominent social thinker has helped put the events of our time in perspective. C. P. Snow said: "During all human history until this century, the rate of social change has been very slow. So slow, that it could pass unnoticed in one person's lifetime. That is no longer so. The rate of change has increased so much that our imagination can't keep up."

In the book, Redesigning the Future, we are warned that because of an increased rate of technological change, social environmental crises are generated and come to a head more rapidly today than in any previous time, so quicker responses are required.

The busing crisis in Boston reminds us that this country has been arguing school integration, busing and related questions for more than 20 years. The decision goes all the way back to 1954 in Brown vs. the Board of Education. Certainly the Supreme Court at that time expected that this country would begin solving the question of integrated schools immediately following the decision. Failure to respond quickly to such social issues, or the lack of any kind of response at all, causes disruptive protests, discontent, alienation or civil disobedience. Repressive measures are often society's response to civil disruptions. Repression stimulates additional protests and disruptions. We have created a cycle: Protest, repression, protest. The cycle either intensifies or leads to indifference. Both outcomes are damaging.

As educators, we must make certain that our traditional programs, attitudes and approaches come to grips with the challenges a technological age produces. Our subject matter is closely tied to industry. We are all aware of the elements of direct cost related to technological change. Design, engineering, labor, raw materials, plant, equipment, packaging, marketing and distribution are the direct costs. One of our challenges is to make certain our students are equally aware of the indirect costs — waste dumped into rivers, smoke pollution, dislocation of workers, radioactivity — in other words, the negative effects of technology.

We must know and understand the total cost of progress. We are learning. In 1971 Congress decided it did not want to finance the development of a supersonic transport. That decision, some maintain, cost this national financially and caused it to lose air leadership. Some congressmen decided, however, intercontinental transportation at speeds of 1,800 miles per hour was not worth the serious risk of noise pollution caused by sonic booms. Others were deeply concerned that emissions from the aircraft weakened the earth's ozone shield. It seemed possible that high speeds at out-of-sight altitudes could drastically upset the whole planet's ecological balance and force each of us to pay the cost of a fast trip from New York to London whether we were aboard the SST or not. From the news reports of recent weeks, we still may.

There is another environment in which we find ourselves — the educational environment. There have always been changes in the total educational scene, but the 1960's was the decade of curriculum reform. It started officially in physics, precipitated by Sputnik. A group of physicists at MIT, led by Zacharias, developed a curriculum based on understanding concepts of physics through appropriate experiments. It came to be called PSSC physics (Physical Science Study Committee). Practically all other fields followed suit during the next 10 years.

Industrial arts, too, was active. Over 20 curriculum projects, large and small, came forth. Major funded projects were Stout's American Industry and Ohio State's Industrial Arts Curriculum Project. Others were the Alberta Plan, the Maryland Plan, the Maine State Plan, the Georgia Plan and the Richmond Plan. There were the Cluster Concept, the Correlated Curriculum Project, the Functions of Industry, Industriology, and the Orchestrated Systems.

A great deal of thinking, debating and coursework were done. The profession searched for new ideas and many came forth.

While we don't hear as much about such projects today, each has contributed to new directions. Several influences came from this work to affect today's industrial arts curricula.

1. Most of the projects presented a need and basis for a broader, integrated view of things, rather than a series of unrelated pieces. For some the broad subject is industry. For others, it is technology. For a few it is the world of work. But all proposed a broad view.

2. In keeping with this idea, most dealt with concepts and their understanding. There was a desire to develop structures to organize and give meaning to facts.

3. Most tried to come up with some new and exciting activities, often involving groups of students, rather than individuals.

4. Most proposed a problemsolving approach.

The national movement most recently on the scene is career education. This became prominent in the 1970's when Sidney Marland became commissioner of education. Economic factors, such as a slowdown in the job market, and social factors, such as a desire to see more responsible citizens who knew how to work and wanted to, made this a popular thrust.

Career education has the possibility of making a great impact on all of education but especially on industrial arts. To many in our field, this is our kind of education. Regardless of philosophy, the possibility of increased support for our work has made this an attractive approach. Several results can be observed already:

1. Some have made a major shift to rather direct vocational preparation in industrial arts.
2. Some have conceived career education very broadly and viewed industrial arts as a place to develop broad career competencies.
3. The dichotomy between general education and occupational education has largely disappeared.

The environment in which we find ourselves today is dynamic and compelling. We cannot ignore it.

All conditions and developments have made the message very clear to us — industrial arts can and must focus on society's needs and problems. This is both a responsibility and an opportunity. It can open doors to the significance of our field. If we don't accept this challenge, we will become very unimportant on the scene. If we do accept it, we will make a major contribution. Industrial arts teachers can influence individual students and through them, society. Industrial arts as a field can make an impact on society in general.

As a profession we have sought to provide meaning and direction to our work by stating objectives and goals. We are all familiar with the several national publications that provided objectives for our profession. Many state and local curriculum guides have extended the national statements by listing more specific goals and individual courses of study have detailed expected outcomes with varying degrees of specificity.

A study of the goals and objectives proposed over the years illustrates what we have considered important and what we feel will give our field status and support. Many of the goal statements have retained their basic essence over the years, but have been modified to fit changing needs and conditions.

Today I would like to use the concept of thrust, rather than goals or objectives. With the theme I have chosen, "industrial arts must focus on societal problems," it is more productive to think in terms of thrusts rather than objectives or goals. Thrusts imply focused action. They are directional rather than specific and detailed.

Let me propose the following thrusts for industrial arts. Two of them have long been incorporated in our field though they have been reinterpreted and modified with changing conditions. The third has not received much emphasis, but is extremely important and timely, and I believe it will add significance to our work.

THRUST 1: THE STUDY OF INDUSTRY. INDUSTRIAL ARTS CAN PROVIDE A CONTEXT IN WHICH TO UNDERSTAND MODERN SOCIETY

Most of our professional publications for the past 30 years have placed emphasis on teaching students about industry. Three objectives, drawn from one state and two national bulletins, sound very similar:

1. To work with the elements of industry to gain understanding of how they function in producing goods and services. (5, p.3)
2. To develop an insight and understanding of industry and its place in our culture. (4, p.9)
3. To develop in each student an insight and understanding of industry and its place in our society. (2, p.4)

So much of our life is influenced by the fact that our goods and services are provided through the institution of industry. Industry is the vehicle through which our technology is made available to all and is a dominant contributor to a high material standard of living. We have come to accept this. We accept, even anticipate, that new car models will come forth annually, that new clothing styles will be created periodically, that new foods will be available, that new television series will start each fall. We need to understand how all this comes to be.

A word here on methodology may be appropriate. There is often a tendency to feel that if we deal with certain kinds of content, our teaching will end up as lectures on the subject with students just writing papers and reciting as they often do in many academic classes.

We often find resistance to moving to certain kinds of content because it is felt to be social science. The method of industrial arts — to involve students actively in projects which develop understanding by illustrating principles and concepts with real life activities — is still a sound and exciting approach and should not be abandoned. The choice is not either to convert to social science or to remain with the traditional content of industrial arts. Rather, it is a challenge to develop real, life-like and interesting student activities which develop understanding of important concepts.

Work done under a special project, coordinated with The Wisconsin Guide to Local Curriculum Improvement in Industrial Education (5), for example, provides outlines and activities to aid in this kind of teaching. Examples of units prepared include: Introduction to Production Technology, The Development of Industry, An Overview of Marketing and Distribution, Maintenance and Services, What is Communications? How Industry Uses Management, and Power and Energy.

Early approaches to industrial arts emphasized activity by the student and used trade-type activities in wood and metal as a means of interpreting industry. The idea was to involve students in real industrial activities at a time when industry was skilled tradesmen at work.

The curriculum projects of the 1960's broadened the approach to content for interpreting industry. The mass production approach with each student performing a specialized task gave a more realistic view of industrial practice. Other approaches included many more of the activities of the manufacturing industry: Setting up and financing a company, doing market surveys, designing products, setting them up for manufacture, operating and controlling a production line, performing quality control, selling products and distributing profits. Other approaches emphasized research and development, materials testing, and product design. The service industries have received less consistent attention from a broad overview standpoint.

Our field has made considerable strides in giving students a comprehensive view of industry as a provider of goods and services in our society.

THRUST 2: CAREER EDUCATION. INDUSTRIAL ARTS CAN MAKE A MAJOR CONTRIBUTION TO CAREER EDUCATION

For years we argued the vocational/general education approach in industrial arts. Many definitions of industrial arts carried the caution that industrial arts is not vocational education.

The career education movement provided a new basis for justifying the exploration and development of various skills and knowledge that are related to the world of work. Career education gives a broader definition, puts into context some objectives we have claimed for some time.

Again, quoting from one state and two national bulletins, our curriculum writers have said that industrial arts exists to enable students:

1. To discover and develop talents, aptitudes, interests and potentialities of individuals for the technical pursuits and applied sciences. (4, p.10)
2. To explore occupational areas as a basis for selecting a career and understanding the pursuits of others. (5, p.3)
3. To discover and develop student talents in industrial-technical fields. (2, p.4)

Industrial arts can deal with many careers rather directly because the source of our content is the industrial world. But there is another aspect, at least as important: The teaching methods we can and should use call for the development of many of the habits, attitudes and work modes that are involved with all occupations, not just industrial pursuits. Industrial arts can thus develop career habits regardless of the career a person chooses. This may be the most valuable career education we can provide for many.

We hear so much that young people are undecided about what they want to do. As a teacher, you can significantly aid students to make some tentative choices. Making a choice gives direction, even if the choice is later modified. The personal attention you give to an individual can be a significant force in his or her life.

This is an area where the efforts of teachers can have a direct influence on students. Teachers should not underestimate the impact they can have on individual students. Henry Adams said, "A teacher affects eternity. He can never tell where his influence stops."

On the other hand, the best possible curriculum, the best facilities, the latest teaching techniques or the latest information in the field all suffer in the hands of a dull, disinterested, unimaginative teacher. One becomes aware of the power of the individual teacher in recalling Anne Mansfield Sullivan and her work with Helen Keller. Helen Keller was blind, deaf and mute. Anne Sullivan demonstrated the power of teaching by turning darkness into light and silence into sound. Through her efforts, Helen Keller became a national figure, recognized by world leaders, universities and governments thousands of miles away from the small Alabama town where she was born.

Glenn T. Seaborg, former chairman of the Atomic Energy Commission, showed absolutely no scientific proficiency or particular interest until he encountered Dwight Logan Reid, one of his high school teachers. Until meeting Reid, Seaborg was a typical student. He played football, mowed lawns and had his own paper route. Reid, an enthusiastic science teacher, inspired Seaborg to develop interest in chemistry and physics. From the small mining town in Michigan where he was born, Seaborg went on to supervise the 3 billion dollar organization that administered national laboratories, manufactured fissionable materials, developed reactors and produced atomic power. In addition he became a chief advisor to President Kennedy on atomic affairs.

It is often said that broad societal changes come as a result of the composite impact of individual upon individual, teacher upon student. Yours is an immense power.

THRUST 3: TECHNOLOGICAL RESPONSIBILITY. INDUSTRIAL ARTS CAN BE THE MAJOR EDUCATIONAL ELEMENT TO FOCUS EXTENSIVE AND INTENSIVE ATTENTION ON TECHNOLOGICAL/SOCIAL PROBLEMS AND THEIR SOLUTIONS

The first two thrusts have a considerable history in industrial arts and have developed from simple to more complex ideas as our society has become more complex. I believe that a third thrust for our field is now appropriate, and concern for it constitutes a next step in the development of industrial arts.

This country prides itself on its progressive development of technology and its ability to put that technology to work in improving our standard of living.

There is, on the other hand, a deepening pessimism concerning the social role of technology. The number of students seeking engineering degrees declined during the late 1960's. Reform politicians accuse governments of neglect of the poor while spending heavily on technology. Weapons of war and the defenses against them, always heavily technological, taint technology itself as murderous.

Transportation, power, extraction and production technologies are viewed by the public as principal polluters. The great American dream of two cars in each garage has become the great American catastrophe of noxious fumes and landscapes clogged with billboards along acres of concrete freeways.

Factories and power plants produce clouds of debris which have reduced the overall sunlight by as much as 15 percent and raise the specter of atmospheric inversions which could suffocate the earth in a poisonous choking blanket. This then produces the "greenhouse effect" in which the sun's radiation is locked in, the heat cannot return to the atmosphere, the earth's temperature rises, and the glaciers melt into torrential floods.

Computers are seen as dehumanizing monsters as they threaten individual privacy in large data banks and foster large scale unemployment through industrial automation.

However, life as we know it today would not exist without the many technological devices and systems we have. It is important that we as a society understand this and make wise and prudent use of our efforts. Industrial arts is one subject area, perhaps the only one, where these concepts can be studied in depth and in a practical way. We have all the resources at our disposal to engage in such a study. It is important that we focus our efforts to that end.

I am not proposing a new curriculum for industrial arts that would throw out what is currently being done. Experience with problems created by technology and attacks on those problems can be incorporated into existing classes.

A problem in the search for alternate forms of power can call for design and construction of devices for converting wind into electricity. The devices can be simple and tested by subjecting them to the blast of an electric fan or extremely sophisticated and tested in natural winds.

Experiments with electric vehicles, either full-sized or scale models, can test efficiency against pollution. More sophisticated studies must investigate the pollution

created by the generation of the electricity for the storage battery. Experiments with mass transit may provide other solutions. Devices for recycling materials can be built and tested with experiments in the use of materials recycled. Experiments with solar heating and heat pumps call upon the skills and knowledges taught in many of our courses. The emphasis on efficiency, conservation and new sources of energy are simply ways of looking at the use of these competencies.

We have developed an idea in Wisconsin that we hope industrial arts people in our home state will find exciting and valuable. We call it "Technology for Society." It involves industrial arts in Wisconsin adopting a "theme of the year" each year and then developing junior and senior high school students' learning projects and competition around that theme. The theme chosen will deal with an important current technological problem which has considerable societal impact. For 1976-77 we have chosen sources of energy. In future years we may consider such themes as: Alternate Forms of Transportation, Design for Adaptability vs. Design for Obsolescence, Improving the Environment, or Housing to Improve Living.

Certainly it is unlikely that junior or senior high school students will solve problems that have baffled industry and business, but the attention paid to such problems by thousands of students and their teachers can encourage, enhance and even force attention by others. At least a realistic view of the needs can result.

The activity can be incorporated in existing classes; it could be a club activity; it could be an individual student's outside extracurricular project; it could be a whole new course. The possibilities are endless and can be adapted to individual situations.

The point is that by participating in this program, Wisconsin's students will not be idle on the sidelines while important decisions relating to technology and their future are made. We want students to be aware of the impact before decisions are made. Given some experience with this, it can perhaps become a model for a national program. We all have a stake in the solutions of public problems. As major problems rise to the top of the public agenda, we need to understand their implications and have a chance to respond. Our problems are worldwide and interrelated. The solutions touch upon everyone of us.

Further, I believe the efforts of thousands of students and their teachers studying significant problems and putting their ideas on display will place the value of our field before the public.

CONCLUSION

Ours is a changing society. Many problems face us today in number and intensity previously unmatched. We have claimed that education is a major answer of our country in making democracy work. Industrial arts is a relatively recent addition to the curriculum, but we have moved through a maturing process to a point where I believe we can make the significant contributions essential to survival. It is up to you. Let's get at it.

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The Last Three Decades with the Browns

George H. Ditlow

There are times when one is called upon for such an occasion as this to provide greetings, say a few words on behalf of a person, or give some type of special speech. When Rick Boller heard some of us were coming from Millersville to participate in this occasion, he indicated that it would be most appropriate if one of us would comment about Dr. and Mrs. Brown, with emphasis upon their involvement in and upon the industrial arts profession at the national level.

Ken, before I start I am reminded of a story at this point for which I would like to have you pay particular heed. It seems there were two old-timers having a rather heated discussion in an old folks home. One, however, seemed to be doing most of the talking. This went on for several minutes while the second man waited patiently for an opening to present his side of the argument. Just when it appeared the first man was about to run down and the second could get in a few words, the one who was talking summed up his argument vehemently, then promptly turned off his hearing aid. Perhaps I should do this?

Upon accepting this task, I sensed a dichotomy immediately. How could anyone who knows anything about what these two people have done throughout the years ever present even a resume of these activities in a brief time interval?

How could one possibly relate the problems inherent in the transfer of responsibilities of the position as Executive Secretary of the American Industrial Arts Association into the hands of Dr. Brown? This all happened before I ever met him. I am sure of one thing; whoever made the decision to have Ken take on these duties must have known him very well. What talents had they in mind for such a person? Kindness and a keen sense of humor, knowledge about the profession and ability to keep things on an even keel. Willing to work with others without wages and carry through the wishes of the executive board. Backbone strong enough to carry a back-breaking job, backstopped by a capable bride who could provide enough back-talk and who could badger him and keep him from becoming too backward, bail him out of trouble without too much ballyhoo.

You see, I could go on and on, but this should be sufficient to portray the thoughts of those illustrious leaders who 25 or more years ago were looking for someone with the K. W. Brown background and selected K. W. Brown for the job. He was a natural. Someone once said, "The physical stature of a man is not as important as what he is made of inside." The executive board at that time chose a man who had his feet on the ground and knew where the industrial arts profession should be headed. Therefore, upon completion of the selection process, Ken was provided with a shoe box which contained the entire records of the American Industrial Arts Association. I am sure both Ken and Margaret can relate many more details about these first days and their apprehension about pursuing the tasks ahead.

How can I begin to tell you about the growth of the industrial arts profession through the efforts of such men as Ken Brown and those whom he worked with during the past 25 years? My first personal acquaintance with Ken and Margaret was in 1955 in Atlantic City. At once, the image presented at the registration desk by this couple as they greeted members and guests was inspiring, both personally and professionally.

By 1958 I had attended three national conferences of the American Industrial Arts Association and learned upon returning from Boston that Ely Van Hart was planning to retire from the position as Conference Director for American Industrial Arts Association. At this point I had my first and only reservations as to the mental stability and professional judgment of Ken Brown, since it was at this point in our lives that he was instrumental in nominating me to replace Mr. Van Hart. As I recall, at this point Ken and Margaret conveniently planned a weekend visit with their good friend, and then my boss, Dr. Burl Osburn. I did not sense any diabolic plot even when they invited me out for dinner (at the local college dining hall). But somehow, by the time we had completed lunch, I had become convinced for some unknown reason that I was the "natural for the job." I mention this to illustrate the type of man we honor here this evening. He knew what had to be done, he planned well as to how it could be accomplished, then he convinced those of us who worked with him that there was just no one else around who was capable of performing the tasks he asked us to assume. One of his expressions I can remember

well was "There is nothing so easy but that it becomes difficult when you do it with reluctance." Also, "Experience is what you get when you are expecting something else." In attempting to relate to you the problems which arose during the 60's, I find it difficult because there is so much to be said. Perhaps this can best be illustrated by the following poem entitled, "The Miracle."

Now, two little frogs in the course of their way,
Fell into a pitcher of cream one day,
And though they both frantically struggled about,
Quite obviously, neither one could get out.

Whereupon, said the first, "Why struggle at all?
The cream is too deep and the pitcher too tall.
I could have leaped out if I had had room."
Thus, blaming his fate, he sank down to his doom.

But the second frog said, "Now, I must confess,
I've certainly got myself into a mess.
Things look mighty bad, but at least, I can fight,"
And he began kicking with all of his might;

And he thrashed and he struggled; he splashed and he tore,
And when he grew weary, he only thrashed more,
Till a miracle happened, as miracles do
For the fellow who just won't admit that he's through —

The cream he was kicking grew thicker and thick
Until there was finally no more need to kick!
And, wondering how such good luck came about,
He crouched on the butter he'd made — and leaped out!

Yes, Ken and Margaret faced a tremendous task when they took over, but they did accomplish a miracle. During the 60's it was time for the American Industrial Arts Association to assume its rightful role and place within the structure of NEA in Washington. The shoe box of files had grown to such an extent in Buffalo that the Browns were forced to enlarge their home to provide space for the function of the office. Ken was instrumental in convincing the Executive Board that we had now reached a stage of maturity where cream became butter, and we within the profession needed to leap out of his pitcher of a home. The American Industrial Arts Association could now afford to hire a full-time professional with appropriate secretarial staff and space which would reflect the image of the growing, vibrant association of professionals we had become. It was here that he urged us on as illustrated through the words of Calvin Coolidge:

> Nothing in the world can take the place of persistence. Talent will not; nothing is more common than unsuccessful men with talent. Genius will not; unrewarded genius is almost a proverb. Education will not; the world is full of educated derelicts. Persistence and determination alone are omnipotent. The slogan "Press On" has solved, and will always solve, the problems of the human race (profession).

It was during this decade of the 60's that Ken relinquished the formal functions as a manager and director. Fortunately, however, this provided more time for him to devote his energies to other areas of leadership within the profession.

The industrial arts facilities and staff at Buffalo, the many students and peer associates he encouraged, prodded and assisted have now assumed their role and positions within the profession and are carrying on the philosophy, goals and ambitions as practiced by Ken during the latter part of the 60's and into the 70's.

A brief check of the history of the profession will reveal the growth in American Industrial Arts Association membership and attendance at conventions, quality and quantity of professional publications, and rapport with other professions, industries and lay persons. Those who were involved with leadership responsibilities within the profession during the 50's and 60's know only too well just how much both Ken and Margaret gave of themselves to further the goals and purposes of our profession.

And, one must remember that this was all accomplished while raising a family and continuing a full-time job at Buffalo. After all, he had to have some income; the Execu-

tive Secretary position of the American Industrial Arts Association had become the most demanding, time consuming non-paying job in the profession. During this period we got to know Buffalo as the center of our country, from a professional point of view. I am sure we will always remember it that way. You must all share our pride in the attainment of such a position of esteem among your peer institutions throughout the country.

And Ken and Margaret—I think we will remember you best by two of my favorite passages. The first is through the words of Stephen Grellet, a French-born Quaker who said, "We shall pass through this world but once. Any good we can do, or any kindness that we can show any human being, let us do it now and not defer it. For we shall not pass this way again."

The other, from an unknown author, is a poem entitled "A Piece of Clay":

I took a piece of plastic clay
And idly fashioned it one day,
And, as my fingers pressed it still,
It moved and yielded to my will.

I came again when days were past
The bit of clay was hard at last;
The form I gave it, it still bore,
But I could change that form no more.

I took a piece of living clay,
And gently formed it day by day;
And molded it with power and art,
A young boy's soft and yielding heart.

I came again when years were gone
It was a man I looked upon;
He still the early impress wore,
And I could change him never more.

In conclusion, Ken and Margaret, on behalf of all of us, I feel that we here tonight and those who could not be with us represent living pieces of clay, and I for one am forever grateful for sharing a small part in your lives somewhere. May God bless you both now and always.

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AIAA General Session #2 Greetings

Gary R. Gunning

On behalf of the American Industrial Arts College Student Association, I would like to acknowledge, welcome and challenge everyone here at this Crossroads '76 conference.

First, the college student association would like to thank the American Industrial Arts Association—each of you—for being that source of personal contact, dedicated commitment, and continual support for students as an important, preprofessional part of the American Industrial Arts Association.

Second, I would like to welcome everyone here at this crossroads of the U.S.A. Yes, we are truly at the crossroads—not only geographically, but also historically, philosophically, professionally and educationally.

This year we are celebrating 200 years of American ideals, 200 years of our people standing at the crossroads of life, trying to learn about the rights of the individual in a democratic society. We can be thankful that our nation is still continuing to define and exercise the rights and freedoms of its people in our modern day society.

Additionally, this centennial conference of the American Industrial Arts Association commemorates one century of the recognized need for teaching our people how to use and live in our technological society.

During the last 100 years of industrial arts educational existence, many noted, envisionary, talented and dedicated professionals have gone out on one of those proverbial limbs, straddled an uncomfortable picket fence or walked that narrow line to blaze trails and roads for the field of industrial arts education.

A quick review and survey of our professional publications during the last 10 to 15 years will point out several mileposts already identified, labeled, categorized and problem solved. These road markers have been checked off with that embarrassing color of red k that all good teachers use for marking papers, projects and labeling those long lasting things called the sacred cows of education.

How many of those sacred cows of industrial arts are just barely out of sight and mind in the back 40 acres where they have gotten quite fat and sassy from years of feeding on inattention, apathy and ignorance?

For those who have helped to do away with a sacred cow or two, we extend our thanks for helping to make the roads safer to travel for all of us approaching the crossroads.

Of the remaining sacred cows and the new obstacles or undefined problem areas that we are facing for tomorrow, our undivided attention, combined efforts and logical minds need to be focused on the horizon to set realistic, long range goals for our profession.

There are many reasons why something can't be done, why it shouldn't be or won't be done and why somebody else should do it, but I believe in the people gathered here, at this American Industrial Arts Association Conference, this April evening of 1976, here at the crossroads.

The question is, can we get it all together enough to agree on who we are who have assembled here at the crossroads?

Which crossroad or way will we choose to take from where we are, and how will this choice be decided? Will the decision be made by a chance flip of the coin in some backroom Executive Board meeting? Or will an informed population of professional educators and concerned users of our technology make objective analyses and utilize some latest type of computerized compass? Which choices will head us off in a direction that will get us successfully to that next centennial celebration for industrial arts education?

Once we have decided why we are here and where we are headed, how will we get there? Will our vehicle be a small hand-crafted, hand-pulled wagon that was made using manual arts techniques that have been held sacred during the last century of our profession? Or will we decide to use the latest, most educationally sound, efficiently designed and futuristically balanced vehicle that our technology and our expertise can give us?

Possibly the most important issue at the crossroads we've come to is: Why are we here? Why did each of us make those series of decisions that led to our being here this week? Why aren't more of our fellow professionals here? What are we doing here anyway?

What new ideas and observations from Crossroads '76 have you already seen? Will these ideas be implemented and shared with our many associates in our own local crossroads area?

We, the college students, want to encourage everyone to absorb all that they can from the programs of Crossroads '76. Next, find out how far you can ride the traditional "conference highs" to which we have all been exposed. When you get home, share as much of that intangible stuff which is so very abundant and real right here tonight — that stuff called professionalism. Find out if professionalism can be contagious.

We don't pretend to have very many, or possibly even any of the answers to these crossroad questions. But on behalf of the American Industrial Arts College Student Association, I challenge you to question yourself and your fellow professionals about who we are, what we are doing here, and where we are headed as we explore Crossroads '76.

Mr. Gunning is 1975-76 President of AIACSA.

Technological Society at a Crossroads

Hazel Henderson

I will begin by proposing a context for this time that we will spend together, which may help us all communicate and share our widely differing experiences. An enormous number of arguments and misunderstandings between people of goodwill seem to occur because they did not exchange some basic information at the outset. The dialogue can be made much easier if each of us clarifies first where we see ourselves in time and space. Where are you in the total system? Do you most often experience yourself on a planet? As a citizen of the United States? As a member of a local community? As a family member or as an individual? Similarly, what time frames do you commonly employ? Is a "long time" a millenium, a century, 5 years or 3 weeks?

Learning to examine our own space-time frameworks and the mental models they generate of the system we inhabit is now of the utmost importance for our survival. "Reality" is what we pay attention to, that selective image of the external world which, as Kenneth Boulding points out, we pull in on our own personal, perceptual "TV screens."[1] Therefore, in order to make myself more explicit, I will tell you where I think I am in space-time, and what mental models my perception has generated and by which I experience "reality."

I believe that I inhabit a rather undistinguished solar system in an arm of an equally unremarkable spiral galaxy, and I also inhabit a body, evolved from the elements of one of the prettiest planets in this solar system. The mental models this experience of perception generates are systemic and interactive, multidimensional, balancing both equilibrium and dynamic behavior modes and evolving over time in some purposive manner which I believe that I shall never understand. There seem to be elements of subsystem expansion and contraction, ordering and disordering, entropy and syntropy continuously occurring, along with energy/matter/information transformations. The most puzzling aspect for me is how I am a part of this process and yet seem to also experience myself as an observer of it as well. But let us for the moment leave such mind-body, subjective-objective, observer-observed paradoxes to the adventurous young physicists who are trying to deal with them as they were posed by Werner Heisenburg in his famous "Uncertainty Principle."[2]

I believe that human survival now requires an awareness that transcends our very natural anthropocentrism. Each great knowledge explosion in our history has been based on such a new level of expanded awareness, from Ptolemy's view of the sun and stars revolving around us on Earth, to the Copernican revolution which reduced us to a subordinate position in the universe. Darwin further undermined our proud image with his theories of evolution, and much of today's new knowledge is increasingly shattering our sense of self-importance, whether studying ourselves as components of living ecosystems or as infinitely malleable creatures viewed by behaviorist B. F. Skinner in Beyond Freedom and Dignity,[3] whose profoundest emotions are nothing but electrical stimulation, reproducible by brain-probing instruments. Now we learn that two more of our claims to uniqueness are being debunked: Dolphins and other mammals have well developed languages, and many other species use tools, including even the lowly ant, which loads food supplies on leaf fragments and thus multiplies its transport capabilities tenfold.[4] We are just becoming aware of ecosystems as immanent information. For example, it has been shown that grasses in typical grazing pastures are capable of growing themselves tougher and more unpalatable by increasing the cellulose content of their leaves in order to drive off excessive numbers of grazing animals.[5]

But let us not be dismayed by this disturbing new evidence of our need for greater humility. Let us instead relax, enjoy our natural curiosity and indulge the new burst of imagination and speculation it creates. Imagination, indeed, has always been one of our most important survival tools. We must now employ imagination to help us deal with the perceptual crisis that is upon us, as our species has now multiplied almost to the limits of its ecological niche on this planet. This perceptual crisis has two aspects: (1) We are experiencing an implosion, as space and resources diminish relative to our growing population. We feel the loss of frontiers, the slowing of economic expansion, urban crowding and the evaporation of many of our historically defined freedoms. (2) At the same time we experience ourselves getting smaller and less significant as old perceptual

boundaries fall away. Paradoxically, as we feel physically confined and frustrated, we are also confronted with an expanded mental model of the universe. We are again facing the oldest human dilemma: A consciousness that can wander among planets, stars and millennia, but trapped in a few dollars worth of chemicals, which will degrade in a few brief years. In short, we must again face the fact of our own death and finiteness, as the old games our cultures have provided to shield us from this reality break down and become destructive and inappropriate for the new conditions, leaving us shorn of psychological clothes to protect ourselves.

Imagination is already coming to our aid again. As physical forms of growth are foreclosed, we are learning to make some new psychological "elbow room" in diversifying lifestyles and in fashioning new images to help us expand our consciousnesses for the next evolutionary leap we must now make. We might imagine ourselves as a termite colony, up to now living happily for all its generations in a beam in the basement of a house. We have developed elaborate social structures and academic disciplines: Termite geography, termite mathematics, physics, engineering and economics. Suddenly our current generation has used up and transformed the beam and emerged at its external surfaces. Not only does this change all the conditions within the colony and its beam, but the roof of the house seems to have blown off and the wall seems to have collapsed! Survival now requires a reconstruction of a more appropriate geography, physics, math, etc. so as to incorporate the new variables and expanded boundaries and contexts.

Now let us imagine together that we are extraterrestrial visitors from one of the millions of planets in our galaxy which may have conditions hospitable to life. We are further evolved than the life forms on the Earth. We zero in our spacecraft and approach this planet. It is not important where we land; it all looks the same: A sphere of blue and white with brown patches visible below. The spot where we land is apparently called by its humanoid inhabitants, "Des Moines" — it doesn't matter, it is as good as anywhere to begin our exploration. We wander around (first taking the precaution of dematerializing ourselves so as not to scare the humanoids) and peek in a large building at a gathering of them. These humanoids are discussing something they call "industrial arts," its future and their own future on this planet. It is all very confusing: They still seem to be debating whether or not their planet is a spherical, finite system. We extraterrestrials know that from the vantage point of our own highly developed technology, it is not really a closed system. But from the humanoids' current levels of technology, it still is. The trouble seems to be that the humanoids have not yet internalized the learning experience that their first costly venture into space provided. They created all that hardware, flashed back from the moon tv pictures of their actual situation, but have done little, it seems, to overhaul and reprogram their educational, political and economic systems to conform with what they have learned. Still we are encouraged to find these humanoids at least arguing and debating how to do this.

To resume our human perspective, it is indeed encouraging to know that this great debate is on the agenda. At least we are addressing at many levels our propensity to create hardware without writing the necessary software to program its orderly functioning. For example, we have with our technology created an interdependent, global economy, and now we are desperately trying to write the program of software: Monetary agreements and international rules to operate it without catastrophic breakdowns. In the 1976 industrial arts yearbook, Future Alternatives for Industrial Arts, these new challenges of global interdependence are recognized by many contributors including Paul DeVore and Donald Lauda, who note three specific crucial aspects of interdependence: Materials, energy and technology.[6]

I have often pondered on why we are so much better at creating hardware than at designing the software to go with it. At one level, it is rooted in our fear of death and nonexistence.[7] When we build cities, dams and factories, we provide for our material requirements, but we also affirm our existence and importance. These physical artifacts are so tangible that they reassure us of our own reality. Another root of our interest in hardware is that humans love to manipulate their surroundings and enjoy the sense of mastery and control these activities confer, as well as the expression of self in such creation and play. Yet another explanation may be that we would rather project our inner tensions and conflicts onto the objective world than resolve them by examining our own psyches and trying to retool ourselves. Last, I hope you will forgive me for wondering whether this passion for hardware is not a result of a cultural overdose of the masculine consciousness? The masculine psyche does seem more attuned (either biologically or by

cultural conditioning) to manipulating external things and objects, while the female psyche seems similarly more attuned to software, interpersonal and social relationships and arrangements.

Technology, defined as knowledge systematically applied to human problemsolving, means software as well as hardware. For example, the social security system and income tax withholding are as much technologies as any hardware system. Lewis Mumford in the Myth of the Machine drew our attention to our bias toward hardware in anthropology and archeology.[8] He pointed out that when we dig for evidence of earlier cultures, such remains are tangible by definition. They are hardware, whether arrowheads, axes, pots or other artifacts. We infer from the extent and elaboration of these artifacts their level of civilization. We often forget that many cultures may have existed without leaving a trace. They could have developed highly refined technologies, but of the software variety: Techniques of conflict resolution, supportive interpersonal relationships, production systems based on elaborate barter, reciprocity and redistributive schemes, as well as myths and taboos to regulate antisocial behavior without use of jails, clubs or physical restraints. A culture which elaborated such software techniques would have had little need for spears and arrowheads and might have had few energies left over to elaborate its tools, and so we might assume too casually because there were few tangible remains that it was less civilized.

In the same vein, I recently visited Japan and talked with a project director at the Japan Techno-Economics Society who was directing an effort to computer-model the value system of the Japanese people. He pointed out that it was possible to infer from the quantities and configurations of material artifacts and technologies created by various cultures a great deal about their value systems. For example, he mentioned that the culture of the Balinese, who create exquisite music, dances, rituals, stories and clothes, are rather disinterested in hardware. On the other end of the scale are the Americans, who are fascinated with and produce more hardware than any culture the world has ever known. We are even unable to enjoy leisure activities such as hiking, without an incredible quantity of gear. Our energy- and materials-intensive hobbies, such as those involving snowmobiles, beach buggies and camping vehicles, are uniquely extravagant.

Similarly, we know that values are the dominant variables driving not only technological but the economic systems. Relationships have been established between Judeo-Christian religious beliefs and the rise of capitalism and the industrial revolution.[9] E. F. Schumacher describes in his book, Small is Beautiful, the value system that drives Bhuddist economics, where labor is an output of production, rather than an input, embodied in the idea of "right livelihood," where work is a valuable mode of self-actualization, while the product is of secondary importance.[10]

We in this culture may at last be awakening from that altered state of consciousness which Thomas Berry calls "the technological trance" and all the unthinking assumptions underlying it.[11] The most destructive of these beliefs is that we see innovation and technological progress mostly in terms of hardware and as continuous, and rarely recognize limits or the concepts of balance and paradox. This technological trance has led us on with a mirage of "efficiency" as its will-o-the-wisp. Our technological consciousness has permitted us to conquer nature (temporarily at least), expand our ecological niche and manage more of the variables affecting our existence. But the trade-off is that as we proceed with this process the task of managing these proliferating variables becomes ever more complex and onerous, until we find that we need "a breakthrough a day to keep the crisis at bay." We lose sight of the fact that some human and natural processes are not susceptible to increased efficiency. Women still understand this better than men: it still takes 9 months to make a baby and 200 years to grow a mature hardwood tree. And while human interactions can be increased and made faster with technology, they are rarely made better, and sometimes are made worse. A companion myth is that new technologies will always be able to be "de-bugged" if only we wait long enough.

Let us look at some contemporary examples of this mirage of efficiency. A recent one is the effort of officials in the U.S. Postal Service to reduce inefficient human labor and replace it with elaborate, automated machines for sorting our mail. After reducing the human workforce, adding to the ranks of the unemployed and investing millions in capital, they find that the machines are ripping, crushing or destroying an alarming number of parcels.[12] Perhaps it might have been more socially efficient to add 1 million unemployed workers to the Postal Service, increasing the care in handling while reinstating the twice-a-day mail service our forbears took for granted.

Another more somber example is the effort of electric utilities to seek efficiency in larger and larger generating plants and substituting nuclear power for less costly and violent technologies. For this increasingly suspect and evanescent efficiency, they are willing to assume risks on our behalf and trade social efficiency, since costly and elaborate police and security systems will have to be invented to contain and manage the deadly plutonium now and for thousands of years to come. This is not to mention the additional societal costs which must be paid in the loss of many cherished civil liberties. Already consumers and citizens are in full-scale revolt against these social inefficiencies.[13]

Yet another example is the current effort of supermarkets to automate checkout counters in search of greater efficiency. You can see as well as I can that the word efficiency is fast becoming meaningless. We must ask in all cases, "Efficient for whom?" We are now more aware that if the term, efficiency, is to mean anything, time and space coordinates must be specified. We must know over what time-frame efficiency is to be maximized: For 1 year as in corporate balance sheets, for 5 years or for sustained-yield, long-term productivity? Similarly, we must know at what system level efficiency is to be maximized: At the individual level or the corporate level? Or do we mean societal efficiency or ecosystem efficiency?[14] All these different time-space specifications of efficiency require quite different policies for their implementation. Indeed, in an economy with nearly 8 percent of the workforce unemployed, corporate efficiency may be served by further automation and capital-intensity, while social efficiency is suboptimized, because taxpayers must foot the bills for unemployment and welfare payments.

I believe that our economy has overshot the mark in its substitution of capital for labor. In fact, I contend that in hundreds of production and service processes, labor has now become the more efficient factor of production. As natural resources become increasingly scarce we must employ our human resources more fully. In fact, a resource-conserving economy must by definition be a full-employment economy as well as a more environmentally benign one. On a world scale this capital/labor ratio has obviously shifted to labor, because not only is capital scarce, but as natural resources are becoming scarcer, people are becoming more plentiful. But in our own U.S. economy, the capital/labor ratio has shifted back to labor for other reasons: We have been subsidizing the overuse of capital relative to labor through investment tax credits, etc.,[15] while at the same time we have been using linear-extrapolation projections of labor costs which conceal the fact that relative to capital, materials and energy, labor is now cheaper in many industries and services.[16] Another reason we are over-substituting capital for labor is due to economists' confusion about the concept of productivity. They measure productivity as output-per-man-hour. This is a measure of how much more capital has been placed at the disposal of each worker. As economists examine these capital-enriched production processes, they measure these predictable increases in productivity case by case, while overlooking the fact that these processes all tend to shake out more and more workers at the bottom of the economy where their productivity has now fallen to below zero! Therefore, we need additional average productivity measures across the whole workforce, including those who are able-bodied but unable to find work.[17]

Indeed, it is the current combination of high unemployment, inflation and shortages of capital, energy and materials that now are signaling the limits of macroeconomic management. Our society is now negotiating what I have called "The Coming Economic Transition," from a maximum materials-throughput system based on nonrenewable resources to a minimum-throughput, recycling economy, based on renewable resources and managed for sustained-yield, long-term productivity.[18] In dealing with this difficult transition and the new productive system we must now put in place, we are facing social and conceptual limits to growth. The social limits are now clearly visible in most industrialized economies in the backlog of soaring social and environmental costs (dismissed by economists, in almost a Freudian slip, as "externalities"). These include not only cleaning up after the mess created by mass production and consumption, but dealing with the drop-outs from urban complexity and massive, incomprehensible technology; mediating the social conflicts; controlling crime; and attempting to coordinate the whole and maintain social homeostasis.

I have proposed that far from achieving Daniel Bell's salubrious vision of the post-industrial state, we may well be heading for what I call "the entropy state."[19] I define the entropy state as a society that has reached such levels of complexity and interdependence that it has become unmodelable, and therefore unmanageable. Such a society

then begins generating so many unanticipated social costs that these cumulative transaction costs begin growing exponentially and exceed the society's real production. Like a physical system, it winds down of its own weight into a state of entropic equilibrium with little further useful potential. I believe that many industrial societies are now exhibiting this syndrome, and many may have already drifted to a soft landing in a steady state, with inflation masking their declining condition. Ironically, since the inadequate formulation of the gross national product indicators adds in all these rising social costs as if they were real, useful production, we are further deceived when the GNP rises.[20]

Mature industrial societies reaching the entropy stage seem to generate two additional causes for their increased inflation rates not understandable from the perspective of economics: (1) These rising, systemic transaction costs of excessive complexity, which are best understood from the vantage point of general systems theory; for example, inflation can be viewed more accurately as a multiple crisis of suboptimization; and (2) an additional contributing factor best measured by thermodynamic analysis, which arises when a society on a declining resource base must continually cycle back more of its real wealth into the process of extracting its energy and materials from ever more degraded and inaccessible deposits of resources, resulting in lower net yields.[21] Consequently, although people may be fully employed and economic activity remains high, it is a wheel-spinning process in which fewer real goods and services are produced, and so the currency itself progressively loses its real purchasing power. All of this is viewed through the inadequate lens of economics as a single phenomenon called inflation or as a declining productivity of capital and a capital shortage. There is little understanding of the noneconomic causes of these phenomena, of the fact that we are now squandering our last precious store of "cheap" capital amassed from easily extracted resources and of the fact that it represents a vital stock of flexibility which is as much of a meta-level resource as coal or oil.

We now realize that we must learn humility if we are to face these complexities we have created. We sense the truth that only the system can manage the system and see the airy arrogance in some of our concepts of management and administration. We examine anew the easy assumptions that sociotechnical systems are even susceptible to manipulation by legislation, just as ancient kings learned that they could not affect the behavior of natural systems by royal decree. We marvel once more at the ingenuity of primitive cultures, whose most obvious characteristic is the relative absence of government because social controls have been internalized.[22] We are indeed at a crossroads, faced with our own sociotechnical complexity. We can take one path, that of stepping up the computer power to model these complexities and progress further down the road to the computerized Leviathan state George Orwell warned of in his novel, 1984. Or we can take not the Luddite's axe, but the surgeon's scalpel, and try to disentangle some of the unnecessary interlinkages and the over-coherent technologies themselves, and by such decentralizing of means, try to reduce the numbers of interacting variables that must now be managed.

We also realize that hard choices and trade-offs must now be made, not just as to budget priorities between education, transportation, health or more private consumption; or between R and D priorities, public and private investments, capital or labor-intensive production, energy alternatives. There is a new range of now-visible meta-choices, such as between further centralization or decentralization and between maintaining a stock of societal flexibility and options versus making current investments which may hard-program society into unsustainable or irreversible patterns. These meta-level trade-offs are visible in every societal subsystem from governmental and corporate organizations to the educational system, where maintaining capital plant and equipment must be traded off against flexibility and adaptability, while similar choices must be made in teacher-training and student curricula. At the personal level educators must also deal with these new trade-offs, whether to specialize further or to expand their horizons into interdisciplinary studies, even at the expense of rigor as academically-defined and rewarded, and whether to trade expanded consciousness for greater secular power and emoluments. We see that such goals conflict because knowledge has become the servant of power in too many cases, and our educational enterprises have too often turned out intellectual mercenaries, whose lances are for hire to justify policies of entrenched bureaucracies and interest groups rather than to merely search for the truth.[23]

At last we see that science is not neutral, nor is technology, and its pretentions to value-free objectivity are now debasing the currency of public debate and preventing us

from making adequate social choices.[24] For example, economics is now obscuring the needed debate about what is valuable under the new constraints and conditions we face. Technology now creates its own social configurations, and we must ask to what extent the continued drive toward big-bang, capital-intensive technologies simply concentrates power, wealth and knowledge in fewer and fewer hands, while making the rest of us poorer and more powerless, while actually increasing overall human ignorance?[25] At least it is now clear that the free market is not working to direct technological innovation to consumer demand as it should. If it were, we would not now have a debate raging about the appropriateness of technology, which has spilled out of the market choice arena into the realm of social and political choice. All this was predicted in 1944 by Karl Polanyi in his study of human production and exchange systems, The Great Transformation. Polanyi pointed out that leaving resource allocations to a free market system would merely suboptimize the social system while leading to rapid environmental depletion. He demonstrated that free markets, far from being derived from some natural order or human behavioral laws, as Adam Smith thought, were created by carefully designed human planning and software. The conditions thus created for the operation of free markets were bitterly contested and legislated over many decades. This new package of social legislation, which enclosed land so that it might be marketed as a commodity and drove off peasants so as to require them to sell their labor as a commodity, laid the groundwork for the industrial revolution.[26] Here again this increase in efficiency of production was won at a terrible price in social dislocation and inefficiency. In the larger scale of human history, market systems are a mere blip associated with the rise of industrialism and actually have been a rare aberration in human societies. As the industrial system has reached its present complexity, system theorist Todd LaPorte asserts that markets can no longer allocate resources where production has indivisible social consequences.[27]

This brief discussion of market failure is necessary if we are to properly assess technology and try to simulate its likely second-order consequences. Each major technological innovation redistributes power, destroys some jobs and creates others, rearranges population patterns and creates new ranks of winners and losers. Technologies do not arise in a vacuum. There is always a force field of institutional vested interests whose interactions may tend to promote or suppress technologies. For example, the institutional and financial commitments to nuclear power have starved solar energy for decades, as James C. Fletcher, administrator of NASA, pointed out recently.[28] Therefore, to keep technology assessments intellectually honest, it is necessary to appoint representatives of potentially-impacted constituencies, such as labor, consumers and environmentalists, to their review panels — a mode of operation I have encouraged at the U.S. Office of Technology Assessment.[29]

The technology assessment debate can also be focused around whether technologies are producer-driven or consumer-responsive. As the shortage of capital and inflation force tougher social choices, cost-benefit and risk-benefit analyses become more difficult. For example, a typical producer-driven technology is a new brain-scanning device which costs about 500,000 dollars and is very valuable to diagnose obscure brain diseases undetectable by other procedures. This scanner, therefore, need only be used in rare cases, and a large output of such devices seems unjustified. Yet the promoters of this scanner successfully raised capital and went into marketing of the devices to hospitals. Hospitals have bought large numbers of them because their huge cost could be recovered quickly by adding this diagnostic procedure to their normal health check-up routines and charging extra money. The question remains, with limited resources can a society permit capital to flow into this type of questionable technological proliferation when perhaps health dollars spent on disease-preventive education or other more vital but less glamorous equipment might pay off many times greater benefits?

What I am suggesting is that the debate in which you have been engaged about the content or the renaming of industrial arts is a crucial one — for you and for society. I agree with many of the contributors to Future Alternatives for Industrial Arts that the vitally needed curriculum is the study of the technology/society interface and such problems as I have just described which baffle us all. Luckily industrial arts curricula have always been interdisciplinary, so you have already jumped that hurdle so difficult for the traditional disciplines. I also agree with Paul DeVore that studying technology is an intellectual discipline.[30] But in expanding the boundaries of awareness for industrial arts to conceptualize better the new intellectual framework for studying technology, I would urge you to conserve what is most valuable and almost unique in industrial arts,

the experiential modes it offers students. As our conceptual backdrop expands, we must never forget that most humans learn experientially. If you visit and lecture at colleges as I do, you will find that the engineering, chemistry and physics students have steered their professors out of the lofty classroom-based conceptualizing and into the open air. There they are doing hands-on experiments with small-scale, renewable-resource, appropriate technologies, whether the methane gas production from bioconversion solar energy collectors, wind generators or hosts of other soft, as opposed to hard, technologies, as summarized in the article by Ronald M. Mangano in the February 1976 AIAA journal, MAN/SOCIETY/TECHNOLOGY.

I can report the sheer joy in the faces of physics professors working with their hands constructing these vital, experimental, ecologically-sustainable technologies. The great merit of industrial arts has always been its power of integration. Today all of us must learn to study whole systems with our whole integrated selves, rather than in the fragmented, reductionist Cartesian Tower of Babel that much academic learning has become.[31] We see too in the resurgence of interest and delight in the crafts, the limitations of other human satisfactions inherent in the welter of cooky-cutter, mass-produced goods. I suggest that as industrial arts continues expanding into the study of technology and society, that a body of ready-made literature exists in the hundreds of small new magazines of appropriate technology, entrepreneurship and self-sufficiency, such as The Whole Earth Catalog, Mother Earth News, The Journal of the New Alchemists, Co-Evolution Quarterly, Rain and others, as well as the books of E. F. Schumacher, Ivan Illich and David Dickson, such as Small Is Beautiful, Tools for Conviviality and Alternative Technology. The study of alternative technological modes and how to integrate them into human cultures, while drawing on your rich, experiential tradition, will assure the continued relevance of industrial arts, by whatever name, for the foreseeable future. The Bucky fulfilling dreams of technology-based hedonism, where machines would work and people would be trained for leisure were, I believe, premature and based on inadequate ecological models. They will remain beyond our reach until we learn to control our population, reduce the impacts of our technology and share our resources more equitably.

I hope that, eventually, some of us will see the advent of the ultimate industrial revolution, the revolution from hardware to software. One day a problem of production may not automatically trigger visions of a factory, machinery or hardware at all. Instead we may learn to stop and think harder and with more subtlety. We will then scan suitable natural ecosystems for signs of the natural capability we seek or for useful biological potential that we can tap into or augment. This bioengineering approach is already leading to a design revolution and a rethinking of many problems of production and energy and materials management. For example, many architects are now designing houses with passive heating systems, i.e., so constructing and positioning the house to take advantage of natural solar and wind conditions that it will not need a heating unit at all. Or take the production of nitrogen fertilizers. This does not require factories, but can be approached by recycling animal and human wastes or by genetically engineering plants to augment their own nitrogen-fixing capabilities. The lowly joruba plant that grows wild in the U.S. southwest desert regions is a rich source of petroleum, while plants "mine" millions of tons of important industrial minerals every year by collecting them from the soil and storing them in their roots, where they are accessible for extraction.[32]

Our planet is more marvellous than we yet understand, and our own capabilities and imaginations will be stretched by the current crises of our dying industrial system. You, in industrial arts, are transcending the old system and rising to meet and guide these new levels of human awareness, as are those in so many other fields undergoing creative ferment. Time is short, but we can all do no less than play our part in this human evolutionary struggle.

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Remarks

Robert D. Benton

Chairperson Frank Cackowski, distinguished platform guests, fellow teachers and leaders in industrial arts throughout the world.

It is indeed an honor to be here before you in this year of our country's bicentennial and at the same time celebrating here in Iowa this very fine industrial arts centennial conference — 100 years of industrial arts as an important and successful contributor to the educational curriculum in the United States.

I am delighted with the appropriate title for this conference. Indeed "crossroads" most clearly represents what I believe is our current choice: Either to realize or not to realize the major role and responsibilities which industrial arts may now play as we increasingly see the need for academic teaching to be augmented by the need for educational experiences relating to the world of living outside of the school room.

The industrial arts instructional format demonstrates that programs can deal with the whole student, provide education that goes beyond the classic academic education of book learning and bring students into a world of reality in which they are involved in realistic learning situations that add a dimension of feeling and an expression of accomplishment. Moreover, industrial arts programs promote an understanding of the workings of the industrialized world outside of school and an opportunity for students to participate in experiences that help prepare for career choices and future occupations.

I am pleased to report to you that we in Iowa have not neglected our planning in industrial arts. Our efforts, beginning in 1973 with a project funded by our State Department of Public Instruction intended to research the most current thinking in industrial arts, resulted in the development of a new and what we consider an innovative curriculum guide. This project entailed the cooperative assistance of our very fine industrial arts teacher training institutions, practitioners already working in the field and consultants from the Department of Public Instruction.

The Iowa curriculum for industrial arts improvement project currently being implemented is designed to focus on the individual student and provide instruction within a context that provides ample recognition for the need for cognitive skills, the psychomotor or student-doing skills and affective learning. The new industrial arts curriculum guide is now in the process of being disseminated throughout the state and is being introduced to educators through a series of 5-hour workshops conducted by teams from our newly established area education agencies. These workshops will be augmented by additional inservice activities supported by the Department of Public Instruction that will lead to industrial arts models that can be adopted by other local school districts.

We certainly anticipate that industrial arts will play an important part in the new thrust for career education that has captured the attention and imagination of educators and the lay public. Industrial arts has a long experience of identifying with the world of work by providing experiences in simulated work activities leading to understandings, appreciations and potential career options for the students. Traditionally industrial arts programs have demonstrated a balance or blending between academic experiences and vocational work preparation experiences.

Industrial arts, by addressing the cognitive, psychomotor and affective domains in the context of industry as an institution, and also the technologies of industry, provides a powerful example of what many educators have expressed should be incorporated in the career education thrust in all teaching disciplines. Industrial arts is an existing segment of our curriculum that provides students with many of the necessary skills with which to cope and negotiate with the real world of work and many other aspects of living such as consumer education, vocational interests and useful understandings of 20th century technology.

Yes, industrial arts is here, established and a viable part of our curriculum and will, we hope, capture the opportunity to provide key leadership by example and demonstration of what is necessary to realize fully the potentials of career education. The need is to recognize and maximize the already existing potential of industrial arts. I see that your conference program topics already indicate this direction is being realized — that an emphasis is being placed on new techniques and innovative programs.

I commend you for being here today and taking your valuable time to participate in

this excellent conference. I know this participation will result in important developments that will be reflected in changes in curriculum and will provide additional significant contributions to the overall national thrust in career education — meeting our responsibilities to provide the type of educational options required for our youth at this time.

I know we are all most anxious to hear Dr. True's presentation. I am also delighted that he mentions excellence in education in his title. We have rested too long with the term, "adequate," in education. Adequate is not enough. Excellence in education is what our goals and expectations should be, and this is why we are here today.

Dr. Benton is State Superintendent of Public Instruction, Iowa.

General Session #3 Speaker

Herbert True, a former professor at the University of Notre Dame and now president of TEAM International, speaks on motivation, creativity, management and the psychology of humor. His address at the 3rd General Session of the 1976 AIAA Conference, "Teaching Excellence in Preparing Youth for a Technological Tomorrow," in which he discussed the importance of excellence in education in an ever-accelerating technological age, is copyrighted and therefore is not published in the proceedings. Many of his presentations are available on tapes and in books through other sources.

ACESIA Special Interest Sessions American Council for Elementary School Industrial Arts

Enhancing Reading and Listening Skills Utilizing Industrial Arts Activities

Clarence R. Calder, Jr.

In the book that I coauthored in 1970, Techniques and Activities to Stimulate Verbal Learning, we illustrated how industrial arts techniques and activities can be utilized to enhance reading and listening skills in an elementary school program. Parts two and three of the book are concerned with specific techniques that can be utilized singly or in combination to develop a variety of instructional materials or learning materials. The techniques suggested are: Layout, lettering, sketching, printing, papier mache, frame construction, solid block construction, hand tools and materials.

Layout techniques can be utilized in the reproduction or juxtaposition of various representatives with a high degree of accuracy.

Lettering techniques provide the classroom teacher with a consistent and immediate tool for representing the words and letters being learned. Through manuscript, we have the means by which the learner is taught to write.

Sketching techniques can be utilized by the classroom teacher as visual language. The technique is most valuable when used as a means rather than as an end in itself. The teacher should not see sketching as art, but as an adjunct to the communication of ideas to the learner.

Printing techniques enable the classroom teacher and the learner to make a vast number of teaching materials. These techniques can be used to make charts, booklets, counters, games, pictures and shapes that enrich or facilitate the learning experience.

Papier mache can be used easily and successfully to create puppets, props, models and masks. These materials can be utilized to sustain the learner's interest and to foster his skills in research, reading and language development.

Frame construction provides a technique for making props or a realistic setting for dramatization, role playing, and simulated game situations, thus stimulating the imagination and providing excellent practice in oral language and in human and social relations.

Solid block construction can be used for the replication of materials that can depict a period in time. Small-scale model buildings are sometimes desirable in connection with studies of the community, the farm, colonial life, transportation or the westward movement. For example, homes around the world can be constructed and the basic features and characteristics researched with emphasis placed on the geographic determinants that dictate the types of roofs, sizes and shapes of buildings, construction materials and general design.

Hand tools and materials can be utilized to fabricate instructional materials or the equipment needed in the type of program being suggested.[1]

The first reaction to some of these areas may be that they are not industrial arts, but could be classified as art or crafts. This argument has been going on for many years and we do not have the time today to solve the problem. Furthermore, calling an activity art, crafts, industrial arts, science or social studies may have a direct relationship to why a large percentage of our school population is considered to have some type of learning disability. It may be that our major concern, at least during the learner's early years, should be directly related to how the content areas enrich the language experience. This is consistent with Moffett[2] when he says that the only subject of the schools is

language, since all other subjects are learned in and through language. He goes on to explain that content is what one discourses about; processes are acts of discourses. This is another way of saying that reading, writing, speaking and listening should be taught through content.

However, this idea strikes terror into the hearts of teachers, because the doing proves so much more complicated than the saying.

The purpose of our program at the University of Connecticut was to develop a series of highly motivational reading enrichment activity kits for independent learning experiences in the regular elementary classroom. The program is based on the hypothesis that the learner can be guided to an interest in reading through intrinsic motivational activities that emphasize their immediate needs and interests. The program is also concerned with determining the effects that specially-prepared reading materials would have on improving an individual's ability to read and to carry out manipulative instructions. The booklets also provide the individual with experiences that develop and reinforce skills in the ability to read and follow directions, in basic kinesthetic or manipulative competencies, in visualization (spatial relationships) abilities and listening skills, when a tape is utilized to supplement the written page.

The material used in the program can be described briefly as follows:

1. They consist of individual books and/or tapes of directions for making something (e.g., a balancing clown, spool marionette or music tooter) or conducting a simple electrical experiment.
2. Each book gives simple step-by-step verbal directions for the activity. Illustrations accompany each page of text. These supplement the text, but are so designed that the learner must attend to the text as well as to the illustrations.
3. A single process or activity is developed in each book.
4. The directions are available both in print and audio tape. This enables the learner to select a topic by virtue of his interest, rather than being restricted to those booklets with directions he can read.

A question that may arise from the description of the materials described is, "How do these materials contribute to the learning process for the elementary school learner?" The following examples illustrate some intended classroom uses of these materials:

1. Because the learner must manipulate materials to make something or do something, he gets practice in developing psychomotor skills.
2. Many learners need highly motivated practice in following directions both by listening to them and reading them. The activities described in the booklets provide the learner with a real purpose for close listening or careful reading. (A poor listener who is a good reader can read the directions after he hears them if he needs to.)
3. Since the materials are self-directed, learners can engage in independent study to learn processes and concepts. Thus, a learner can be learning on his own while his teacher is working with other learners.
4. The material can be utilized to evaluate a learner's understanding of a concept. For example, a learner may read the following directions: Fold the piece of construction paper in half the short way. Does the learner understand the concept "Fold Half, Short Way?" His understanding can be determined by evaluating the learner's performance.
   Did he fold the paper?
   Did he fold the paper in half?
   Did he fold the paper the short way?
5. Teachers who are reluctant to utilize industrial arts type activities because of their own lack of skill or because they feel there is not enough time in an already overcrowded day can provide these materials for learners to use in their free time during the day.
6. After a learner has completed an activity, he has knowledge or skill that he can share with his peers. Speaking skills can be reinforced as the learner presents the step-by-step directions to another learner. The activities also provide the learner with an opportunity to develop his skills in organizing and sequencing his ideas and thoughts. For example, a withdrawn or shy learner who becomes skillful in a particular process (making a wooden marionette) is provided the opportunity to share his experience with his peers. He can present the material to one learner or group of learners.
7. Each booklet has suggested activities for follow-up and enrichment. For example, a learner

who is interested could be encouraged to trace the derivation of words used in the directions. The words insulate and terminal are examples taken from an electricity activity booklet. Another example would be for the learner to explain to his peers the scientific principle behind the balancing clown that he has constructed.

DEVELOPMENT OF THE ACTIVITY BOOKLETS

Instructions were written using Durrell's word list to control the reading vocabulary. However, technical words were not changed to conform to the word list. For example, words like "post" or "cover" were not substituted for "terminal" and "insulation" because of their relationship and importance to the topic being developed. Readability was determined by computing the Dale-Chall Formula for each booklet.

Each booklet was then tested in a nearby school. The information collected in the tryout period was used to revise and improve the activity booklets.

UTILIZING THE BOOKLETS IN THE CLASSROOM

An interest center consisting of 45 booklets was established at the back of the classroom. Special portable carrels were constructed to fit on the typical classroom table top. These carrels enabled individuals to work on their selected activities without disturbing other members of the class.

Equipment and supplies necessary to complete any of the manipulative activities were stored in boxes on shelves in the interest center. The activities usually required only materials that would be common to any well-equipped classroom. Bell wire, door bell, 6-volt batteries, tempera paints, string, crayons, paper, paper tubes and blocks of wood are a few examples of materials needed to perform the activities suggested in the various booklets.

UTILIZATION OF THE ACTIVITIES BOOKLETS

Learners were allowed to select and work with an activity booklet any time during the day, provided they had completed their various assignments. For example, learners could visit the center when not working in a reading group or performing a specific assignment in one of the subject areas. Because of space limitations, only eight learners could use the center and its materials at one time. Activity booklets were selected by the learners according to a particular interest. Learners took their selected activity booklets to one of the carrels and followed the written-illustrated instructions to completion. Activities requiring drying or extended working periods were stored by learners until they had free time again.

EVALUATION OF THE PROGRAM

At the end of the school year all learners showed marked improvement in their ability to read and to carry out instructions. There was a notable change in the learners' attitude toward reading. The classroom teachers noted improvement in work habits, self-motivation, self-confidence and reliability.

The following statements indicate the reaction of learners and teachers to using the activity booklets.[3,4,5,6]

Learners' Comments

"For the first time I had to read for a reason."
"I like to make things."
"It isn't like reading a book."
"It gives reading a meaning."
"Can I use these booklets again?"
"May I do the same activity again?"

Teachers' Comments

"Learner is hyperactive and perceptually handicapped, with a normal interest span of 5 minutes; worked for over 25 minutes on one activity."

"Learner showed little reaction at first, but later talked about his finished project for four days."

"Learner stayed in two recesses to work with her activity booklet."
"This was the learner's first positive reaction to any school activity this year."
"Learner worked for 26 minutes; usual interest span is 5 to 6 minutes."

CONCLUSION

The presentation attempts to go beyond those comments we continuously hear, such as:
"Let's interrelate skills and content."
"Let's develop blocks of learning time."
"Let's use our reading skills the entire school day."

I think that this program illustrates what interrelatedness is all about and, more important, how interrelatedness could happen in our elementary schools.

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Putting EST into Action—How We Did It

Betty A. Ford

The purpose of our participation in this conference is to show how we implemented an elementary school technologies (IA) approach to learning in our curriculum. However, we feel that it is equally important to share briefly why we felt this implementation should take place. Here are our answers:

1. Technologies in the classroom makes the curriculum more relevant to the real world. Academic studies are placed in a framework of application to life problems and work situations. Children become aware of and interact with their environment.
2. Technologies in the classroom help prepare children to live in and cope with a technocratic society. Technology provides an orientation to machines and systems. Children learn to see career choices as flexible and variable, so their own abilities and interests may be matched to a variety of occupations.
3. Technologies in the classroom provides an alternative to the strictly academic approach to developing basic skills.
4. Technologies provides a vehicle for developing a positive self concept by emphasizing what one can do, rather than can't do. It provides opportunities for success and fosters the understanding that different people are good at different things.
5. Finally, technologies provides an opportunity for children to develop a systematic approach to problem solving and learning.

Our school, a modified open space school, bases its philosophy of learning on an individualized flexible approach which incorporates team teaching and differentiated staffing. We believe that by providing a variety of alternatives we can enable each child to utilize his most effective learning mode to achieve continuous progress.

We began our project by stating for ourselves and the administration of our school system what we hoped to accomplish, limiting ourselves to realistic guidelines for the project, financially and in staff involvement. It was then decided to implement the program within these limitations for the first year.

Two classroom teams were approached and agreed to implement the program in their classrooms. One was a combined first and second grade classroom, and the other a third grade classroom. Both teams had previously experimented with technology-oriented activities.

We then sought input from various resource agencies and obtained excellent response. James Snyder, the W. Va. Department of Education's IA program specialist, gave us much help, encouragement and guidance. Fairmont State College coordinated some of its teacher training program with our activities, providing us with additional personnel for complicated projects, as well as enabling members of its faculty to act as additional resource people for us. We were able to provide laboratory experiences for students in the teacher training program where these opportunities had not existed in the past.

We also found parents and businessmen interested and cooperative in providing volunteer time and materials for some of our projects. Parents have been interested in and supportive of the program, reinforcing our belief in its importance.

As the teaching teams became involved, we found it necessary to reaffirm and clarify our position that we did not want to add an additional subject to an already crowded curriculum. We wanted to view technologies as a method of exemplifying, reinforcing and integrating concepts we were presently developing in various subject areas. While the nature of technologies carries some inherent concepts, we have not codified them into a separate body of learning and currently have no plans to do so.

The teaching teams identified various units of work which had been scheduled for the year and which they felt were particularly adaptable to a technologies approach. They also assisted in formulating concise goals for the program.

We have developed the following goals:

—Improvement of self-concept by students
—Development of a systematic approach to doing work
—Career awareness
—Mastery of safety procedures and appreciation of their importance
—Development of decisionmaking skills
—Development of selfevaluation skills

The teaching teams entered the program with enthusiasm and resourcefulness. They were particularly creative and successful in integrating technologies into their curriculum. They have proved that all subjects may be adapted to a technological teaching method and that technologies provides an excellent vehicle for integrating various subject areas into a focused, applicable body of skills and knowledge.

An additional bonus to the program came early when our special education team became interested in technology activities and saw immediate relevance to their EMR program. They have developed three units to date using technologies, transportation, a holiday unit for Christmas and a personal hygiene unit. Within these units, they have developed skills in the use of tools, following directions, sequencing, classification and problem solving, besides the academic concepts contained in the units.

The first and second grade teaching team has planned two major units and several mini units for this year. The major units were an introduction to map and globe skills and a unit on the construction industry. They have also completed units on metric measurement and time in math and a language arts related unit on following and interpreting written directions.

The third grade teaching team has also planned two major units and has used a technologies approach frequently in all subjects this year. Their two major units were developed for a study of communities and of Hawaii. They also have done several technology projects in math, science and language arts.

Pam Markel, a member of the first-second grade teaching team, described their map skills unit like this:

> We centered our first technology experience on a social studies unit. We wanted the children to understand what a map was and the purpose it served. We wanted them to realize that a map showed direction and distance from place to place. We wanted them to understand

that maps are used for various purposes, and we wanted the children to have many hands-on experiences with maps. We tried to incorporate other subject areas such as math and language arts. The children drew maps of familiar areas in their school and wrote directions. We discussed aerial views and relative position of things as they stood in different places. The children understood and experienced why people need maps.

Linda Dowell, a member of the third grade teaching team, described a unit on communities:

> We planned our unit to show how communities develop from the resources around them. The children built buildings found in a community and constructed their own. They found out why zoning laws were needed; they learned and experienced about voting and the democratic process. They studied the resources of their own community and took one resource to study in depth. They learned that one resource (apples) could be used in many ways. They made applesauce, applebutter, applehead dolls, etc. They experienced line assembly in making a train, since one of their community's industries was a railroad. They learned about tools and, in doing the unit, incorporated math, language arts and science with social studies.

In summary, we found the elementary technologies approach to be a valid instructional method which should be expanded within school systems and in teacher training programs. It has application to all parts of the elementary curriculum, facilitates integration of learning and makes the academic program relevant to modern society. Moreover, it makes learning fun for both students and teachers. It fosters creativity and encourages curiosity and research. We tried it — and we like it!

Mrs. Ford is the curriculum coordinator and assistant principal at Anna Jarvis Elementary School in Grafton, W.Va.

Industrial Education Approach to Career Awareness

Janet Foresman and Marjorie Inman

Industrial Education Approach to Career Awareness is an ESEA Title III project. Funding is through the Wyoming State Department of Education. The project is funded for a 3-year period — originating at the second grade level the first year, K-3 the second year and K-6 the third year. The project was written by Janet Foresman and Marjorie Imman, second grade teachers for the Buffalo Ridge Elementary School, Cheyenne, Wyo.

This program is being developed at Buffalo Ridge Elementary School and St. Mary's Parochial School. This program is supportive to the current career education curriculum designed by Laramie County School District Number One.

Industrial Education Approach to Career Awareness is a project that has changed the traditionally structured program through a hands-on feature that has strengthened the teaching of the basic skills. This type of program would also aid in the psychological development of the children. The hands-on approach should not be a course solely for the purpose of teaching how to use tools but the approach itself should be a teaching method.

NEED

The need for this type of program at the elementary level is to enhance the career and attitude development that initially resides in the local neighborhood school. It will provide appropriate and productive means of meeting the student needs which is the purpose of the Buffalo Ridge project. The program will be available to both girls and boys equally. Through informal surveys the staff at Buffalo Ridge School have determined the following needs:

1. To gain knowledge and understanding of the many areas of occupational opportunities in the local community, to increase knowledge and understanding of the technological relationship of our culture and of the world at large.

2. To develop motor coordination, self-direction and social skills conducive to constructive human interaction.
3. To increase motivation for basic skill development while sustaining positive self-concepts and encouraging curiosity.

PROJECT GOALS

All children will benefit from the experiences provided within the project activities. These educational activities will involve experiences in the cognitive, affective and psychomotor domains.

Project goals are:

1. The students involved in this project will be exposed to the concept of career awareness and the resultant responsibilities associated with the world of work.
2. The concept of career education will be infused within the present district approved curriculum. This infusion will be conducive to social and academic skill development as measured by a teacher-developed base line measurement.
3. The students involved in this project will develop and utilize newly acquired humanistic skills, self-governance and group participation (e.g., good citizenship) as measured by a teacher-developed social scale.
4. This project will operate from a community base model whereby interested and appropriate resource persons and sites will be utilized to their fullest extent.

PROCESS TO ACHIEVE GOALS (UNIT DESCRIPTION)

In the second grade at Buffalo Ridge Elementary School the students study nine career units. These units include the careers that produce a product along with the service careers.

We must emphasize that these units are not separate subjects but correlate and integrate with the present curriculum. It is one which a "hands-on" method is used to make each unit a realistic experience.

"Let's Eat" unit was introduced with the Foods for America, a national program. It was presented to the second grade students by the Future Farmers of America from the high school agriculture department. The teacher's guide provided reading overlays and work dittos to go with each lesson. The FFA students brought farm equipment and animals to the play area and the classroom for the students to see, pet and better understand. The "hands-on" activity was making farm animals using wood, cotton and paper.

A field trip was taken to a dairy farm where the students had the opportunity to see a herd of dairy cattle and calves. They observed the methods of feeding and milking and learned how the milk is taken care of before it is transported for bottling. The class read from their health books and library books about the dairy industry and the value of these products in our daily lives. The class then made ice cream and their own butter. Coordinating with math the students learned liquid measurement of quarts, pints and cups including the fractions of one half, one fourth and one third.

After studying the basic food groups from their health books, the class planned and prepared a breakfast. Using the assembly line process they prepared eggs, bacon, toast and juice with each student having an important job. Student tutors from the high school home economics department gave a helping hand. The class served 70 people without a mishap.

Our art teacher correlated her program with our unit, and the class made a learning bulletin board using paper farm animals and buildings.

The class then talked about the byproducts of the cattle industry. A representative from the Tandy Leather Company visited the class to discuss the different kinds of leather and their uses. The class had the opportunity to experience working with leather making purses, pouches and moccasins.

The Health Occupation Unit, "What's Up Doc," was begun by inviting members of the many different medical professions into the classroom to talk to the students and show the tools of their trade.

An ophthalmologist talked to the children about the parts and functions of the eye. He displayed the instruments used in eye surgery and a large electric magnet used to remove metal objects from the eye. The children enjoyed experimenting with the magnet and its strength.

Employees of the local Blood Bank visited the class and demonstrated the process of drawing blood from a donor. The class observed the process of determining the typing and taking of blood. While the blood was being drawn the class was informed of the need for blood and blood donors.

The Cheyenne Ambulance Service brought an ambulance onto the school playground. The attendants explained what equipment they carry in the ambulance and its use. They also discussed what their duties were as attendants. Of course the demonstration of the different sirens and when they were used brought great excitement among the children.

A dentist spoke to the children. The class viewed filmstrips on dental hygiene. Once again the class had the opportunity to see the instruments used and to hear the explanation of their use.

Student nurses from the University of Wyoming visited the children. They talked about the different types of nursing and the education each required. They demonstrated the use of the stethoscope, how to take blood pressure and how to put on a sling. The children were given the opportunity to use the instruments on each other and were thrilled with hearing their own or friends' heart beat using the stethoscope.

The final session was a visit from two surgical nurses. The nurses came dressed in their uniforms and brought a sterile pack of instruments and uniforms. As they talked about their duties they put on their surgical gowns and gloves, then opened the instruments as if they were actually preparing for surgery. When they completed their demonstration the class was allowed to examine and handle the instruments. This was one of the most interesting areas in health occupations for the children. These nurses helped eliminate some of the fears of surgery for the children.

All through the unit the class used library books relating to health occupations and their health books as references. The children picked the career words they wanted to learn to spell and add to their vocabulary and their regular spelling list. One word out of many that was chosen was "ophthalmologist." Since the challenge was their own choosing it was met with great success. As a culminating activity the class made doctor or nurse shingles out of wood or plastic for their desks.

"Let's Build It" was a unit on Home Construction. Along with teaching awareness about the different careers involved in home construction, this unit is designed to introduce various types of hand tools, the importance of planning and actual construction of a project.

A local contractor came into the classroom and built a small project where the students observed the use of hand tools. He impressed upon the children the need for safety and care of all tools. He designed the plan for his demonstration and showed the children how to go about making a list of materials needed before one starts to actually build.

By reading in their science, social studies and library books the children learn where different building materials come from. The students learned how to use a steel tape and other instruments of measurement through math lessons. Once more while the unit is progressing the children choose the words connected with home construction they want to learn how to spell.

The hands-on activity was to build a bird house. The children began by using a grid to draw up plans. They were taken in groups of eight or ten to begin sawing their lumber and putting together the bird houses.

While some students were working with wood the rest of the class were in various centers doing such activities as making leather pouches, weaving, embroidering, designing and making wall hangings and constructing projects out of styrofoam. Each child rotated through each center before the unit was completed.

In this unit of study, student tutors were used from the high school industrial education classes. The elementary students develop a close relationship with the student tutors.

Throughout this unit the class takes many field trips to watch the progress of homes being built in their neighborhood.

A unit on Manufacturing Careers, "We Make Lots of Stuff," was begun by a field trip to a clothing manufacturing company, Alpine Design, where the class had a first hand view of the working of an assembly line. Each child was made aware of the importance of each job and the need for cooperation while working together.

With the use of selected library books and their social studies book the class began preparation for setting up their own company and assembly line. The students decided to make puppets and formed the Wooden Spoon Puppet Company.

Since the children were making wooden spoon puppets, they needed to learn some basic sewing skills such as putting in a simple casing, hemming and sewing on buttons. A high school home economics class was contacted, and six girls came to the classroom as student tutors to aid the children in their sewing. Both boys and girls made their own puppet dress.

Officers were elected for the company and the rest of the class was tested to find the skilled and semi-skilled workers. Each student understood that they had a special job and the importance of that job on the assembly line. As the spoons moved down the assembly line the faces, hair, headbands and dresses were put on each spoon.

As each puppet was completed they were packaged as if they were going to be shipped. At the end of the "working day" each employee was paid by a check drawn on the Buffalo Ridge Bank (set up by the children) for the number of hours they worked.

As a mathematics lesson the class found out the minimum wage a worker could earn. They figured the number of hours they would be working, thereby arriving at the amount each worker would be paid.

Throughout this unit a notebook in the shape of a doll was kept which included the children's creative writing, mathematic problems and career spelling words.

"Come Travel With Us," a unit on Transportation, brought about a great deal of eagerness with the second graders.

The class took many field trips to visit the different forms of transportation found in our community. Some of the places they visited were the airport, Air National Guard, a truck terminal, a bus depot and train station.

The children were taken by commercial bus to Laramie, Wyoming, where they visited the University of Wyoming campus. They had the experience of returning on an Amtrak train.

The second graders read about the different careers involved in transportation in their social studies text and chosen library books. Maps and world globes were examined. Drawings of simple maps by the students were made and displayed.

The children had a choice of making various types of transportation projects in the hands-on activity. Some of these were cars, trucks, planes, trains, boats, rockets and others (imaginative or real). This was one project the boys especially enjoyed.

Paper airplanes were made using different types of paper. The class was divided into groups with each group using a different weight and kind of paper. The designs of the airplanes were discussed with the class. A contest was held and each group flew their planes. The planes from each group that flew the best then competed with the other groups. The class then could determine which paper material and design was best for making planes by observing those that had the best flight distance.

"Our Friend The Policeman" is a unit of study on Law Enforcement. At this age level this is a very important unit. Our goal in this unit is to stress that the policeman is one who helps us and not one whom we fear.

To go along with what the children were reading in their social studies textbook and basic reader about law enforcement, community resource persons such as members of the police force, sheriff's department, highway patrol and a probation officer talked to the class about their jobs. The second graders were taken on a field trip to the police station and sheriff's department.

The interest in this area was shown through the type of creative stories and math story problems that the children wrote.

In preparation for the hands-on activity the class studied about simple electrical wiring in their science books. The children worked cooperatively in designing, wiring and putting together an electrical stop light.

"I Really Dig It" was the unit where the students investigated the careers of the archeologist and geologist. This unit has great appeal to second graders because of the study of dinosaurs.

This unit was introduced by the studying of dinosaurs, the different types of rocks and rock formations in their science textbook. Selected library references were brought into the classroom for further information. The children were taken on a field trip to see a museum where a geologist and archeologist talked to the children about the facts they had been reading. The class saw a demonstration on how fossil prints are removed from the ground and how missing parts of a dinosaur are recreated or reconstructed.

The first hands-on activity with this unit was to have the children make their own

fossil print out of oil clay. By using plaster of paris, the children were able to remove the print from the clay.

With the help of the art teacher the students made their own favorite dinosaur from clay. It was fired and painted, then put into a diorama.

This unit lends itself beautifully for a great deal of creative writing experiences. The children enjoyed the challenge of learning to spell the different names of rocks and dinosaurs.

The class spent a good deal of free time locating various types of rocks and trying to identify them.

Each student was given a duplicating master where they wrote their own math story problems about dinosaurs and careers in this unit. After they had their problem and a picture was drawn, each student ran his own master off on the ditto machine. A booklet was compiled and given to each second grader. In this way all the students worked each other's problems and then would return them to the author for correction.

"Me, Myself and I" was the final unit. This part was for self-awareness and creative art.

Community resource people were brought into the classroom to talk to the children about making jewelry, painting, drawing, music and writing of books.

The entire class wrote, illustrated and bound their own creative books. They also made simple rhythm instruments which were used in their music class.

The second graders were given the opportunity to work with wood, leather, plastic, fabric, cardboard, metal and paper to make their own creative projects using the skills they already learned throughout the career awareness units.

This is one of the most rewarding and positive self-image building units for the students.

In May of each year an industrial education exhibit is held where each student from elementary, junior and senior high schools are able to exhibit their projects. For the second graders this is received with great enthusiasm. At this exhibit they compete with other students their age as well as being involved with the older students. Each student receives a ribbon for his work. Each child had the feeling of success.

TEACHER TRAINING

Buffalo Ridge and St. Mary's teachers have been provided with workshops pertaining to career awareness and hands-on activities. These workshops have welcomed the attendance of other interested teachers throughout the Cheyenne School District.

These workshops provide the teachers with the knowledge and skills an elementary teacher can use in the classroom with students.

Local teachers are encouraged to attend industrial education courses offered by the University of Wyoming for elementary teachers.

EVALUATION

Several methods of evaluation have been done such as teacher-developed rating scale for self-direction and social skills, student's own evaluation of each career unit, academic skills measured through the Laramie County Mathematics and Language Arts Continua and psychomotor testing.

Mrs. Foresman and Mrs. Inman are second grade teachers at Buffalo Ridge Elementary School, Cheyenne, Wyo.

Idaho's Approach to Elementary Industrial Arts

Douglas E. Hammer

Elementary industrial arts workshops have been very well received throughout Idaho. Evidences of the industrial arts influence in the elementary school are beginning to show up in newspaper articles and school exhibits throughout the state. During the last two years we have been involved in approximately fifty elementary workshops.

The typical elementary teacher is usually skeptical and hesitant about getting into anything new, especially something that may mean an additional curriculum area. Our basic goal in the elementary workshop is to show teachers hands-on activities that can be related to their existing curriculum areas such as mathematics, science and social studies. While doing this we also offer experiences involving safe use of the basic hand tools. We are convinced students learn to dislike school and that failure is not caused by lack of ability as often as by lack of motivation. If hands-on activities can motivate students to study related subject areas and careers while developing a sense of personal worth through personal accomplishments, we are truly teaching.

Using the basic learning theory: I hear and I forget, I see and I remember, I do and I understand; hands-on elementary industrial arts activities become an essential part of the curriculum.

With this basic introduction I would like to discuss some various activities that relate to elementary education.

Mathematics. Students can construct math counting boards for visual aids in learning numbers and their relationship to each other. Geoboards allow students to set up and see various basic geometric shapes using pegs and rubber bands. Math games use pegs in boards to develop reasoning and logic as it applies to basic problem solving. Tanagrams allow for a study of space relationships. A trundle wheel makes measuring distance fun.

Please note these activities are by no means the total of all possible but do serve to give teachers ideas from which to springboard.

Science. Many of the concepts of science are now being taught using the lab approach. Our activities consist of the construction of a mini-greenhouse for starting plants. Bird feeders relate well to the study of environment and birds. Terrariums allow for plant study. Ant boxes provide an interesting opportunity for students to observe this hard-working insect.

Social Studies. The keepsake hutch allows students to use several different hand tools while constructing an interesting display box for items of particular interest or value to the student.

Weaving looms provide a means to study the basic methods of cloth construction used by pioneers. While using their looms students are also provided an excellent means to develop eye-hand coordination.

By constructing his own toy train, boat or truck the student is able to relate transportation careers and uses to his own item. We have developed a sample unit around the construction of a toy truck which suggests as related activities that students develop their basic truck into a truck that can do work such as a tanker, cattle truck, van or dump truck. Quality and detail will vary with grade level and ability. To encourage more learning we suggest that each student tell us about his truck — what kind it is, what type of work it performs, who does the driving, is truck driving a good job and other related items of interest. Even research can be exciting if it is relevant.

We usually try to include an activity using the basic hand tools and jigs to construct teaching aids for the instructor. The purpose of this activity is to give additional experiences with the tools as well as to provide some good teaching aids for the classroom. It also provides a good opportunity to use a jig and explain the value and industrial relationship of jigs for interchangeable parts.

Reaction and the effect of the workshop have been good. Idaho now has many elementary teachers using the hands-on industrial arts method of reinforcing their curriculum as a result of the workshops.

May I suggest that if you have not tried the hands-on elementary industrial arts you may be missing a good opportunity to turn students back on to learning.

Mr. Hammer is assistant Industrial Arts Supervisor for the Idaho State Department of Vocational Education, Boise.

Multibased ESIA in West Virginia

William K. Hodgkinson

The focus of this portion of the presentation is on the undergraduate elementary school industrial arts efforts in West Virginia. In the undergraduate industrial arts education program at the West Virginia Institute of Technology students are given the opportunity to participate in industrial arts experiences in the elementary school.

"Technology for Children," a suggested-selected elective, upper division course provides a dual function. It gives the industrial arts major an opportunity to be exposed to elementary education and the elementary education major an opportunity to explore industrial arts. This dual purpose class, although slightly more difficult to administer, has provided very meaningful interactions between education majors, each sharing with and gaining from the other in a cooperative atmosphere.

The following instructional modules provide organization for course competencies:

Industrial Arts Education Majors

I. Industrial Arts and the Education of All Children
II. The Elementary School Child
III. The Elementary School Curriculum
IV. The Exceptional Child
V. Developing Activities for the Classroom
VI. The Role of the Elementary School Industrial Arts Consultant

Elementary Education Majors

I. Why Elementary School Industrial Arts?
II. American Industry
III. Industrial Tools, Materials, Processes and Products
IV. Developing Activities for the Classroom
V. Conducting Production Activities

There are essentially three phases to the class. The first, the formal instructional phase, utilizes the instructional modes of lecture/recitation and discussion to develop fundamental understandings of elementary school industrial arts and to introduce its literature.

The second phase, the laboratory experimentation phase, allows the students to explore possible learning alternatives available to teachers and consistent with curricula. Sample activities are designed for hypothetical age-grade-subject situations during this phase. Each student develops, using Learning Activity Development forms (LAD's), learning experiences which enhance the meanings of several different situations. There LAD's (format follows) are executed and the outcomes, projects where applicable, are discussed in class.

LEARNING ACTIVITY DEVELOPMENT FORUM (Koble, 1970)

I. Activity Title
II. Age/Grade Level
III. Time Required
IV. Objectives (behaviorally stated)
V. Rationale
VI. References
VII. Procedure
VIII. Learning Aids (Tools, Equipment, Materials, Supplies, . . .)
IX. Illustration of Activity

The third phase, the observation/participation phase, provides the students actual experiences with the children and teachers in local elementary schools. A functional knowledge of industrial arts in the elementary school is gained through the planning and implementation of a production activity in an elementary class. This cooperative venture between the industrial arts department on campus and the local schools has been most exciting and rewarding for all participants.

Among the benefits accrued through this experience by students and teachers involved has been one significant indirect benefit from this our initial exposure. We have been

cordially invited to present a county inservice workshop this fall to initiate the concept of elementary school industrial arts education county wide.

Dr. Hodgkinson is coordinator of and assistant professor in the Industrial Education Department at West Virginia Technical Institute, Montgomery.

A Self-Directed Workshop in Pre-elementary School Industrial Arts

Ronald L. Koble and David P. Cramer

During the past decade K-6 industrial arts programs have received increasing attention, especially when compared to the 1940's and early 1950's. West and Pinelli estimated that over 2.5 million students were enrolled in elementary school industrial arts in 42 of the 50 states in 1970. (Pinelli, p. 306) The effects of current inflation on elementary school industrial arts, however, remain to be seen.

During the past 5 or 6 years increasing emphasis and funds have been available and used for early childhood education. Head Start is probably the best known of this type of program. These programs, which attempt to prepare children for entry into kindergarten and subsequently the first grade, should cause those industrial arts personnel whose interests have been focused at the K-6 level to ask, "Why should we limit our lower age/grade level to the kindergarten?" and "Is early childhood education a logical and reasonable extension of K-6 industrial arts?"

Actually, there are historic reasons for using "K" as the lower limit. However, because of the current thrust in early childhood education, that is, prekindergarten education, it seems logical to consider extending industrial arts below the kindergarten level. It will of course require replacing the "elementary school" part of our common reference of "elementary school industrial arts." But that should not be a major obstacle.

While it is beyond the scope of this presentation to examine the question of a change in name, a brief reference to the issue seems appropriate. In this instance, it appears that the term "elementary school industrial arts" probably is used more frequently to refer to our activities below the secondary level than any other referent. The term we now use is "Three Dimensional Learning" or TDL.

This leads to a second and final important premise on which this presentation is based. That is, to have a consistent philosophical thrust for a preschool to grade six program, it is necessary to accept the position that our role with preschool as well as K-6 learners is that of providing three-dimensional activities that (1) reduce levels of abstraction, (2) encourage activity-based learning, (3) provide for self-expression and (4) assist children with their physiological development — their sensory motor development. This is important to note: Other K-6 philosophical perspectives, e.g., study of technology, career education and programs with tool skill foci, are inconsistent with the major goals of early childhood education, and in our view K-6 education too!

EARLY CHILDHOOD EDUCATION

According to Evans, the goals of early childhood education are: (1) Socialization, (2) Child's Physical Health Needs, (3) Sensory Motor Development and (4) Emotional Development. (Evans, 1975, p. 53) It can be seen that the one goal of early childhood education of most relevance to us is "sensory motor development" although the other goals also have implications for three-dimensional learning.

A sampling of the gross and fine motor skills for 3-, 4- and 5-year old children synthesized by Karnes, Sprogel and Goldberg illustrate some of the sensory motor skills for these children: Picks up pins, etc. with each eye covered; builds tower of nine cubes; drives nails and pegs; strings four beads; copies circle and letters V, H and T; cuts with scissors; puts round pegs in pegboard holes; holds crayon with fingers and paints pictures with brush on easel.

To help children develop these and other fine motor skills and to aid in their general sensory-motor development, a self-directed workshop was developed for teachers. This is the major focus of our presentation but certainly not of secondary importance to the prior comments related to extending the scope of K-6 programs downward to include ages 3 and 4.

SELF-DIRECTED WORKSHOP

The basic purpose of the workshop is both to help educators of young children assess their knowledge, skills and attitudes about young children and their educational needs and to increase their ability to translate their assessment into relevant educational practices. Therefore, the atmosphere of the workshop was designed to produce active involvement by the participants in the multiple options provided by resource packets, films, consultants, discussion groups and curriculum construction work groups. Working with these types of activity options takes up about 75 percent of the participants' workshop time.

The workshop atmosphere is informal in nature and consists of all the things which contribute to the climate in which the participants must operate. Describing all of the elements that contribute to the total workshop climate is difficult. But the most important elements can be identified and are briefly described.

Participants are greeted by an activity in which they are asked to learn each others' names and to discuss mutual concerns. The informality is also communicated by the room arrangement and the availability of refreshments and comfortable chairs. The workshop staff begin the workshop by joining the participants in their discussions. Through these discussions the content of the workshop is introduced through the use of an initial self-assessment. Following this self-assessment, it is the staff's communication skills that play the most important role in maintaining an informal problem-centered atmosphere.

The task of the workshop staff is to use their communication skills to provide and maintain the appropriate balance of structure, security, stimulation and incentive without eliminating the minimal amounts of frustration, tension and struggle that triggers and sustains the participants' learning and exploration. The staff's major role is to use their verbal behavior, observation and organizational skills to maintain a learner-centered climate. This means the dominant intent of the staff's conversation with the participants is intentionally focused upon the use of problem-structuring statements designed to offer appropriate information, ideas and resources in an objective and nonthreatening manner. They also organize small group and large group activities whose purpose is to sustain and support the participants by facilitating their attempts to complete the self-selected packet activities.

Participant's handbook: Implicit in this type of participant involvement in individualized problem solving is the assumption that the most important learning is not externally imposed but comes from self-directed intellectual activity. Therefore, the educational sequence begins with an initial self-assessment and personal goal setting activities and ends with the participants and workshop leader evaluating the products or practices to be used by the participants in their educational setting. The workshop, therefore, is organized around a participant handbook that consists of a systematically organized listing of packages of core activities, suggested resource packets, opportunities for in-depth reading, study and self-evaluation procedures and criteria.

Initial self-assessment and goal setting: The participants are required to use the information gained in their initial self-assessment to select packet topics and activities located within the packets to demonstrate a competency or develop a product for use in their educational setting. The minimum number of packets and activities within the packets varies and are keyed to the multiple activity options subsequently described.

Learning options: The workshop provides a rich set of opportunities and resources for self-directed learning. After completing the initial self-assessment and goal setting activities, the participants choose from the prepared optional resource packets the particular packets which will help them meet their individual goals. The packets chosen also contain optional activities designed to develop specific competencies or supply factual information about a specific area or topic. In addition to the resource packets, the staff carefully summarizes the participants' choices and then uses them to select and provide other ways for the participants to meet their goals. These include demonstrations, field trips, participant displays, tapes, films, videotapes, consultant presentations and a resource library of books, articles and pamphlets.

FLEXIBLE GROUPING AND TIME SCHEDULING

Grouping and scheduling: During the scheduled workshop periods, the participants elect to work on an individual small or large group basis while they complete the packet activities they have selected according to a self-imposed time schedule. The groups naturally vary in size depending upon the number of participants and the interpersonal relationships that develop between participants and the optional packet activities they have selected.

Self-evaluation: Opportunities for self-evaluation are provided throughout the workshop as the participants complete packet activities. After each activity the participants are asked to demonstrate their increased knowledge, skills, understanding or a product such as a written paper, charts, graphs, video or audio tapes, exhibits, demonstrations or learning materials for children. They receive feedback from their peers as well as a personalized response from the workshop staff. These types of evaluation procedures and the flexible grouping and time scheduling encourage the sharing of increased competency among participants. The result is an improvement in the self-confidence and competency of the participants.

APPLICATION

Examples of actual workshop packets as well as descriptions of actual activities conducted with preschool children are discussed.

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Competencies, Learners and Resources—A Potpourri

H. Terry Leeper, Dennis E. Sheriff and Francis E. Clark

In 1972 Pennsylvania began certifying industrial arts teachers at all levels, kindergarten through twelfth grade. Even though they were certified to teach at the elementary school level, courses related to industrial arts for the elementary grades were not provided or required. The decision was made to conduct a competency study to aid in curriculum development.

The purpose of the study was to determine through a survey the necessary competencies for elementary school industrial arts teachers. The study encouraged college educators, elementary school industrial arts teachers and coordinators to provide input by expressing their needs and desires.

The initial list of competencies was developed by reviewing the following sources: (1) Textbooks, (2) periodical literature, (3) previous research and (4) existing content objectives for industrial arts in the elementary schools. The competency listing was divided into three categories: Skills, attitudes and knowledge.

A questionnaire consisting of 53 competencies was developed and sent to 29 individuals. Of those sent 70 percent were returned. The respondents included the following industrial arts clientele: College and university department heads; coordinators in cities

with populations of 50,000 people or more; authors of elementary industrial arts textbooks; and national coordinators responsible for integrating industrial arts into elementary school programs.

The recipients of the questionnaire were asked to: (1) Rate each competency on a five-point Likert scale, five being the highest rating, (2) indicate those competencies which would not be of significant value to the program, and (3) write in any comments or competencies that would be vital to the study. Once the questionnaires were returned, the responses were analyzed and a mean was calculated for each competency. Suggested additional competencies were recorded, as were deletions. Each competency category (skills, attitudes and knowledge) was analyzed and reported separately.

ANALYSIS OF SKILL COMPETENCIES

Of the 10 skill competencies rated, none fell below a median value of 2.50. The competency rated lowest was given a mean rating of 3.50, while the highest mean value was 4.50. "Skill competencies" as an area was rated quite high since developing skills in children and studying the technology of industry are the primary content areas of an elementary industrial arts program. Individuals indicating comments emphasized the need: (1) To develop solid block-and-frame construction and (2) to use ideas provided by children in the curriculum planning stages.

The areas of "planning and developing" the elementary student's responsibilities were rated highest. The high rating for "planning and developing" is not surprising since this is one of the key objectives of elementary school industrial arts.

ANALYSIS OF ATTITUDE COMPETENCIES

Under the topic of "attitudes," seven competencies were rated between 3.40 and 3.95, while 17 were rated at or above 4.00. The respondents indicated that the success of a program depends upon the attitude of the teacher toward the students. Even though overall program attitudes are important, understanding, caring for and complete development of the student depend upon the instructor.

ANALYSIS OF KNOWLEDGE COMPETENCIES

Under "knowledge," one competency was rated below 2.50, 8 were rated between 3.89 and 4.00, while 12 were rated above 4.00. It is interesting to note that the competency with the lowest rating (2.35) was "applies five or more concepts advanced by Montessori." This rating was probably the result of a lack of understanding on the part of the respondents. Montessori, like many leading elementary educators, provides a frame of reference for analyzing the content within elementary industrial arts programs. On the other hand, the respondents probably centered their interests upon the areas of industrial arts for content development at the elementary school level.

CONCLUSIONS

Based upon responses, the following conclusions were offered:

- None of the colleges or universities in Pennsylvania has an elementary industrial arts program that is required of all industrial arts students.
- Teacher education programs should promote the development of the student's ability in recognizing the differing abilities, responsibilities and activities of elementary school children. In addition children should learn the proper care and use of tools related to the various areas within industrial arts.
- The success of an industrial arts program for the elementary grades depends upon the teacher's attitudes and abilities in regard to developmental levels of children and planned activities.

IMPLICATIONS

In view of the findings and conclusions of this study, the following implications were suggested:

- Colleges and universities offering a program in industrial arts teacher education may include instruction pertaining to the knowledge, attitude and skill competencies needed for elementary school industrial arts teachers.
- Another implication of this study is that public school systems may want to employ teacher competencies as an indicator of program philosophy and content selection.
- Future competency studies of elementary industrial arts teachers should be conducted by employing critical-incident methodology.

COMPETENCIES IN PERSPECTIVE

While the identification of competencies is vitally important, these competencies represent only one component within the total framework of individualized instruction. As a result of this study it became evident that if learning is the ultimate product of the instructional environment, then the instructional environment is the product of the interaction between and among the teacher, the learner, the task and the resources (materials, equipment and methodologies).

It should be realized that the instructional variables dealt with in designing a course for elementary industrial arts teachers are the same instructional variables that these teachers will be dealing with upon employment. Therefore, a portion of the content for the course should be derived from the same decision structure utilized in designing the course. In other words, the course should require elementary industrial arts teachers to make the same decisions about the instructional environment that were made in designing the instructional environment they are experiencing.

This analysis should concentrate on the process of collecting information necessary to reach decisions about what to teach, how to teach and how much to teach in relation to restraints such as costs, time, space, equipment and group size. In essence, the analysis should lead directly to an instructional design that specifies preplanned interactions between and among the teacher, the learner, the task and the resources — resulting in an instructional environment where responses are predictable.

Elementary industrial arts teachers should gain experience in identifying learner capabilities as opposed to deficiencies. If instruction is the transmission of information from one person to another and if we communicate with learners through the senses of hearing, seeing, touching, smelling and tasting, then these learner capabilities become important considerations in the design of the message. Prerequisite internal learning conditions will also influence the way in which the learner is expected to respond to instruction.

When considering resource attributes such as intent, format and restraints — answers to the following questions will serve as guides in designing and selecting media. Is the intent to reinforce, reinstate, provide repetition or verify? Is the intent of the stimulus sensory (subjective) or vicarious (objective) in nature? Is the format sequential or nonsequential, intermittent or continuous pace, resolved or open-ended? Are there cost, time, equipment or space restraints?

To establish the conditions for instruction, the elementary industrial arts teachers should identify the task in the form of an objective. The objective may then be classified according to the conditions of learning advanced by Gagné (1970), and the external conditions that will be controlled during instruction can be described.

At this point in design, decisions about the instructional conditions are made. Identified characteristics of the learner, task and resources are considered along three major dimensions. The objective of this configuration is to correlate the intent, format and restraints of a medium, whatever it may be, to the external conditions of the task and the internal and external attributes of the learner. This decision structure disciplines thinking and allows the elementary industrial arts teachers to make systematic comparisons they may otherwise fail to perceive.

The elimination of unnecessary intuitive and extemporaneous instructional activities is the goal to be achieved by preplanning the unique contributions of both human and nonhuman resources. Beyond master of subject matter, the teacher is characterized as a facilitator of learning and a decisionmaker rather than a taskmaster. Therefore, more time can be devoted to establishing interpersonal relationships with individual learners, a prerequisite to the identification of developmental stages, attention spans and intrinsic and extrinsic motivational levels — dynamic attributes of the learner relating to readiness for instruction.

All of this must be considered without ignoring the implications of common sense, or the capacity of the means — men, machines, skills and money; for if we fail, the prime loser will be the learner.

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Making Industrial Arts an Integral Part of the Preservice Elementary Teacher Education Program

Noah Logan

The magnitude of the task identified in the title of this paper is such that it looms like a Gordian knot[1] blocking the road. Is our professional cutting edge sharp enough, like Alexander the Great, to cut our way through or are we destined to solve the riddle, thus proving ourselves worthy? The latter is probably the more realistic approach for there is not a person in the United States Office of Education to articulate the case for industrial arts in the elementary schools as Sidney P. Marland did for the concept of career education and then apply the full power of the office to bring about curriculum revision.

Furthermore, there is not a public outcry of sufficient magnitude to cause state legislatures to mandate the teaching of industrial arts in the elementary classrooms as was done for consumer education in the Commonwealth of Kentucky in 1974 and career education in 1976.[2] Both the 1974 and 1976 bills did not mention industrial arts; this is ironic because good industrial arts programs have, from the beginning, included strong components in both consumer and career education. One must conclude that if indeed we have been talking outside the professional circle, few people have been listening.

My presentation this afternoon will deal with the program as it has evolved at Morehead State University since 1973. More specifically I will discuss: (1) Conflicting views held by the departments of industrial arts and elementary education, (2) dual certification, (3) appropriate content and method and (4) some details about the Morehead Program. The preceding topics are based on personal experience covering the period from 1970 to the present.

CONFLICTING VIEWS

The conflict between general educationists and those who see the practical arts as a panacea is well known. However, one needs only attempt to work across school lines to see the destructiveness of this senseless conflict. My first experience with this problem came in 1970 when, as director of an Education Professions Development Act grant,[3] I needed to provide experiences for the project participants (elementary teachers) which would improve their ability to develop learning aids for use with culturally disadvantaged children.

Lacking time and funds to handle this problem through a workshop, I began searching for a course into which I could place the project participants. To my surprise the Morehead General Catalog did list Industrial Arts for Elementary Teachers, the course needed, but it had not been offered for many years. A conference with the dean and Industrial Arts faculty of the School of Applied Science and Technology reveal the following: (1) The course had been offered specifically to meet the need of elementary teachers for some understanding of the world of technology and (2) after a substantial initial enrollment the course had consistently failed to attract more than a few students. A later conference with the chairman of the Department of Elementary Education revealed that: (1) The course was viewed initially as a good elective and was recommended and (2) it was

immediately apparent that the course as taught did not, in the opinion of the Elementary Education faculty, meet the needs of their students. Subsequent meetings revealed the depth of misunderstanding and hostility on the part of both schools and an unwillingness of both to make a serious effort to reach an understanding. This appears to have been the rule since no full-time program of industrial arts for elementary teachers is in operation in Kentucky except the one under discussion.

DUAL CERTIFICATION

To the casual observer the solution to better communication and cooperation may seem simple; the fact is, nothing is simple where human emotions and values are involved. The most reasonable approach would seem to be the preparation of personnel who can function effectively in both the elementary classroom and industrial arts laboratory. Therefore, let us consider the feasibility of dual certification and the benefits to be derived from such an approach.

The conversion program for a student who has completed a baccalaureate degree with a major in industrial arts would be approximately thirty credit hours of selected courses in elementary education including a classroom practicum. This would eliminate the argument that industrial arts teachers have little understanding of the problems faced by the elementary classroom teacher.

The student who had graduated with an area of concentration in elementary education should expect to complete a teaching major in industrial arts. The time requirement could be substantially reduced if the undergraduate program was well planned from the beginning. There is no easy solution because the elementary classroom and the industrial arts laboratory are both complex situations. To infuse the content and method of both into a viable alternative classroom organization will require a thorough understanding not only of content and method in both situations but understanding of child growth and development and the learning process. This plan could in a relatively short time produce teachers competent to function as resource persons in the public schools and insure a supply of teacher education professors who could function across school lines.

CONTENT AND METHOD

The question of what is taught and how it is taught is of paramount importance for anyone working in a program of industrial arts for elementary teachers. The simple truth is that most elementary teachers are women and as such have been conditioned to feel that work with tools and materials somehow constituted a threat to their femininity. This is a cultural condition and will not disappear in the near future. For example, I observed a first grade classroom in which the student teacher had brought in a large carton; she then cut windows and doors, painted on wheels and was permitting the children to use it for imaginary bus trips. The boys were driving the bus, taking tickets, performing maintenance and helping the girls to and from their seats. The girls were at no time active participants in this activity. This is not an isolated case but is the rule in many communities. Due to this cultural bias, elementary education students enter industrial arts with a poor self-image. This condition can usually be corrected through the use of values clarification techniques and personal projects, usually teaching aids, which maximize student participation. By midterm most students have developed basic tool skills-and can begin to analyze the content of industrial arts and the project method (both group and individual). The students finish the class by developing a series of learning packets which contain constructional activities and can be carried out by the child in the classroom.

THE MOREHEAD PROGRAM

After an erratic start in the early sixties the course in industrial arts for elementary teachers lay dormant until 1970 when it was revived for a select group of students participating in a research project under EPDA. After only one semester it was allowed to become inactive again.

My interest in the program began with the previously mentioned experience as director of the EPDA project and continued throughout a two year sabbatical during which time I completed my Ed.D. degree with a supporting area in elementary education. Returning

to Morehead I decided to begin developing a program of industrial arts for elementary teachers and was able to negotiate a contract which placed my teaching duties in both the departments of Elementary Education and of Industrial Arts. More specifically, my teaching duties consisted of teaching one section of the professional semester block, foundation courses in elementary education and one course (Industrial Arts for Elementary Teachers) in the Department of Industrial Arts. Thus I was able to move freely within and between both faculties and to a large extent dispel much of the misunderstanding which had wrecked the program 10 years earlier.

The course was offered as I.E. 520 n elective open to junior, senior and graduate students and was initially scheduled only during the spring semester of each school year beginning in 1973. The enrollment was adequate for only one class section. Beginning with the 1975 school year this course has been scheduled each semester, including the summer term, with an enrollment adequate for two class sections. In addition there is an industrial arts component built into the on-campus experiences for all elementary education students enrolled in the professional semester — which means that all Morehead graduates certified to teach in the elementary classroom now routinely receive instruction in the potential of industrial arts activities, as both content and a method, through which children can become more active participants in the learning process regardless of the curriculum area under study.

CONCLUSION

In conclusion, I believe the program at Morehead, while only elective now, will soon become a requirement. This will mean writing a course for the sophomore level and upgrading the present course to only graduate status, making it an attractive elective for education specialist students in Supervision and Administration.

For some time I have been negotiating with the executive officer of a public school system, in the Morehead service area, in an effort to work out the details for a long term study (6 to 10 years) which will combine industrial arts, career and consumer education and will infuse this into the existing elementary curriculum K-6. This idea was presented to the Board of Education on March 13, 1976, and was enthusiastically received.[4] Work on the details of the proposal is underway and it is anticipated that implementation will begin in the fall of 1977. In addition to achievement in all curriculum areas, of special interest is the effect on a dropout rate which is running above fifty percent from grades one through nine.[5] If this project shows a significant improvement in the effectiveness of the public schools, these results will form the basis for a request to the State Board of Education to establish industrial arts as a requirement for certification in elementary education in the Commonwealth of Kentucky.

FOOTNOTES

1. Mythology: King Gordian of Phyrgia tied a knot which an oracle revealed could be undone only by the future Master of Asia. Alexander the Great, failing to untie it, cut the knot with his sword.

2. House Bill 538, Section 9, Effective June 21, 1974, and House Bill 70, sent to the Governor March 10, 1976.

3. United States Office of Education Planning Grant No. OEG-0-9-273153-2147-725 and operating Grant No. OEG -9-70-1735 (725).

4. Resolution No. 155-76 Rowan County Board of Education March 13, 1976.

5. Information on dropouts furnished by the Superintendent of Rowan County Public Schools, 1975.

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New Dimensions in Teaching Effectiveness for Prospective Elementary Teachers

Robert L. McLaren and Ronald G. Barker

In the Department of Industrial Education and Technology at Western Illinois University, we approach teaching elementary education majors and special education majors the constructional activities of industrial arts through our crafts program. We offer a wide gamut of activities in our program from the teaching of basic crafts to units in basic manufacturing. This paper illustrates some of the teaching techniques we use to acquaint prospective teachers with the role of industrial arts in the elementary school program.

The human body has many physical dimensions, i.e., height, arm length, foot, head and waist size. As we grow and develop, we eat a variety of foods and exercise in many ways. There are also many dimensions to the mind and a multitude of ways of developing it.

The elementary school curriculum provides a variety of activities, both physical and mental, to help our children grow and develop into functional, versatile and knowledgeable individuals. Industrial arts activities can supplement the elementary school curriculum by assisting the teacher in developing the "complete" child.

To illustrate our point, let us compare some dimensions or parts of the human body to some of the dimensions or teaching methods of presenting crafts to elementary children.

A leg is a foundation upon which a child's body is built. The foundation of our country was hewn out of the land by the sweat of men's brows. As our country has evolved from a small colony to a mighty industrial giant, yesterday's vocations have become today's crafts. Much can be learned about our heritage from studying and working with crafts as they pertain to social studies.

Our country's heritage was transferred from east to west on the old-time prairie schooner. A man earned his livelihood by handcrafting items. Through the use of hand tools, a man was able to make furnishings for his home and tools for his farm.

One hand crafted item was the candle which brought light into the house. To the pioneer a candle was a necessity, not a luxury. We can teach the same candle-making process today which they used 200 years ago, thus teaching our children about history, candlemaking materials and processes.

Another pioneer task, broom making, which was a vocation, can be used as a craft today to communicate housekeeping skills.

The items pioneers used in clothing were a vital part of their early heritage. For example, buttons were made by early craftsmen from the shells found in abundance along the virgin rivers. There were crops of wool and grain that provided staples of clothing and food for the community. Flax fibers were broken down through a hand process resulting in a very fine gossamer-like fiber which was later woven into cloth to make fine linen. When flax fibers were in short supply, they were combined with wool to provide a material called linsey-woolsey. The basic weaving process, still in use today, can be taught to our children through a weaving craft. The handcraft method of producing cloth has evolved into our great textile industries of today. An opportunity to teach children career education would be to demonstrate, through a constructional activity, the many types of work involved in a textile industry.

Pioneers provided decoration for their drab attire through the use of bead stringing. Job's tears, seeds and other natural materials were used to make jewelry for themselves and ornaments for the home.

The only way most early settlers had to obtain furniture was to build it. Some of the furniture was very simple and basic due to a minimum number of tools and materials and the limited skill of the craftsman. Other pieces were more elaborate and ornamental. There is a renewed interest today in primitive and early American furnishings. Caning, for example, provided functional and decorative seats for chairs, stools and panels.

The pioneer crafts as mentioned can be communicated through present day crafts only in a more decorative and intricate way. Candlemaking, weaving, bead stringing, tile mosaic and block printing are representative of early craft activities relating closely to math, history, science and other subjects vital in the schools of today.

The second leg of our child can utilize the construction of inexpensive crafts. In

today's inflational setting, it will be a relief to parents and boards of education to find ways of cutting expenses. Inexpensive crafts teach children not only about language arts, math and science but also about recycling, ecology, utilization of natural resources and economics.

Nonbiodegradable materials can be turned into productive and useful craft items while teaching some concepts of ecology, tool usage and design to the students. Styrofoam meat trays make decorative Christmas decorations or other seasonal type of crafts. These trays can also be used to make inexpensive relief prints simply by using a fingernail or a pencil to inscribe the design on the styrofoam.

Puppets can be very effective in communications and can be made from discarded nylons, coat hangers and paper scraps. These items cost very little for children to make. Discarded beverage cans can be used to make useful craft items of a nature suitable for elementary or early childhood education. Craft items can be made from bottles, magazines, styrofoam, cardboard, cans, yarn, match sticks and wood scraps — materials that would normally be thrown away. An American flag can be made by using a simple wooden frame, string and construction paper.

The human body cannot function without a backbone. The backbone of our American industry is the mass production concept. In elementary school, children can learn the basic concepts of mass production: Concepts such as cooperation, organization and teamwork.

In most elementary classrooms a mass production activity can be accomplished quite easily. We can utilize hand tools and basic power tools in an elementary classroom to execute a mass production unit. We can demonstrate basic industrial processes, the making of jigs and fixtures and then actually go through the production process. We could mass produce cars to communicate not only high volume industries but also the transportation industry and the type of work and workers involved. Depending on budget and time available, several food items, small crafts or leather objects could be used as a learning experience in mass production for elementary children.

If you are familiar with what happens in the third grade and the note passing that goes on, we can turn that around and make it a useful learning experience. We can mass produce mail boxes and by stacking them together, build a post office. Through the process of role playing, children can be made aware of careers in the post office system, learn how the postal system operates and apply math principles through the buying of envelopes, stationery and stamps.

The arms of our body reach out and grasp objects. The use of teaching aids help children grasp ideas and concepts. It has been said, "A picture is worth a thousand words." A colorful, well-designed teaching aid may implant an idea forever in the mind of a child.

Teaching aids can be used in many different ways. Either the teacher or student may operate them. If we are to work with a puppet stand, the teacher can control the classroom activities and the mood of the children through putting on a skit. This is an effective way to transmit information, similar to what is done on Sesame Street, The Electric Company and other popular children's television shows. On the other hand, children can also operate these puppet stands to communicate stories that they have read or made up, to practice their language arts skills and to present educational material in a structured sense.

Electric boards are also a valuable teaching aid since they give positive reinforcement to the students. Felt boards are another way of communicating with children. Making the boards bright, interesting and current requires some work on the part of the teacher. They can be very effective in the teaching of colors, textures, numbers and other concepts that young children need to learn. Felt boards can be made from wood, cardboard or other suitable materials. A versatile felt board can be constructed from a cardboard carton approximately 2-1/2 feet by 3 feet with storage compartments in the interior for holding the media which will be used on the board. The outside of the board is covered with felt. The felt board can also be used to announce special events.

Still another way of relating information to children is through the use of books. Books that are in the library can be a ready source of information, or you can make your own books. If you are working with children who have learning disabilities, you can design a book to provide experiences in zipping, snapping, tieing, buttoning, buckling and lacing — tasks the child will have to master in learning to dress himself. The book may be made of cloth, paper or other materials.

Other teaching aids can promote math, color concepts and recognition of items the children come in contact with such as traffic symbols, the weather and common household utensils. These teaching aids will not only allow for simple recognition of objects but also will provide opportunities for role-playing and social interaction.

Our child has a second arm for grasping objects. Games and toys are very effective teaching devices which assist children in grasping knowledge concerning concepts such as color, texture, numbers, time, shapes, rhythm and music. Psychomotor skills are improved, i.e., throwing, picking up and stacking and other qualities are promoted and developed such as eye-hand coordination, large motor coordination and sportsmanship (sense of fair play).

Many people today say that play is children's work. Toys can be very useful in the elementary classroom. Games and toys can be purchased from many companies who have utilized experience and research in the construction of their products. Toys can be used to relate educationally, or they can be used for play activities as the children grow. Teachers can develop the ability to construct educational equipment to meet the needs of their students. Toys can be used to communicate a variety of things as follows:

1. A doll house, in its many varied forms, can be used by boys and girls in role playing.
2. Toys can be made to communicate careers of all types.
3. Toys can also be a learning device for manipulative skills, i.e., getting dressed, recognizing colors and textures.
4. Musical toys can be an aid to learning rhythm. A xylophone, slap board, sanding blocks, tambourine and other devices can be used to help stimulate an interest in music and help the children develop rhythm. Children like to sing songs about activities which are important in their lives.
5. Toys can be made to develop perceptual skills. Montessori cylinders, crazy pegs, pounding blocks and stacking games help children to become better coordinated in eye-hand activities, small motor activities and gross motor activities.
6. Puzzles are a good device to develop perception and coordination in children. Teachers can make puzzles very attractive and colorful through the use of wood, coping saws, files, sandpaper, glue and paint. Commercial puzzle pieces often become lost. With a few materials, tools and skills, the classroom teacher can make new pieces so the puzzle can again become useful.
7. Dominoes assist children to develop basic math concepts.
8. Children enjoy stacking blocks. Blocks can be made very easily from a piece of 2 by 4 cut in the shapes of squares, triangles and rectangles. Dowell rods can be used for circular pieces.
9. A bean bag toss game can be a good way of helping children develop psychomotor abilities and interact socially. This game can be used on the playground, in the classroom or in the gym. It can be made free standing and can be transported anywhere.

To complete our body, we have a head which functions as our control center. Our sense of sight, hearing, smell and taste are housed in our head. Display cases and bulletin boards can appeal to the child's senses and transmit knowledge in any curriculum. The child's own works can be used to build a sense of pride, accomplishment and self-confidence through displaying projects and work to others.

Display cases can make learning a pleasure by surrounding one with stimulating and decorative displays. All areas of school can profit by a creative presentation of subject material. To establish interest, create curiosity and stimulate conversation, display cases should be changed frequently.

Display cases can announce events and activities of general interest. In so doing, they help to enrich corridors and to intensify school spirit. The effectiveness of a display case, regardless of its theme, depends upon its arrangement which involves consideration of size, shape, color, variety, balance and other properties.

Holidays, special weeks (Exceptional Children's Week) and themes centered on a specific craft are a few ideas for display cases. Imagination is the key to an effective display case.

We have just looked at a variety of dimensions in teaching effectiveness. To some of you they may be new; to others they may be old. Boredom, apathy and a lack of comprehension are brought about when a teacher uses the same teaching technique constantly. Using the cliche, "Variety is the spice of life," we can realize that in teaching a variety of teaching techniques can and will lead to new dimensions in teaching effectiveness to

stimulate interest and a desire for learning within every child. Therefore, as it takes many dimensions to make up the human body, it also takes many dimensions in teaching to develop a well-informed and well-adjusted child, ready to cope with today's fast moving society.

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Constructional Activities for Special Needs Students

Gary D. Meers and John Bies

Constructional activities in the elementary classroom have been found to provide a number of needed human development skills. These skills can range from self-realization to job satisfaction to task completion, all of which are needed in order for individuals to take their places in our technological society.

Current trends in special education, such as the least restrictive environment or "mainstreaming" bills that states are presently enacting and the Federal Education for All Handicapped Children Act of 1975, place handicapped learners in a variety of settings that never before were accomplished.

The elementary classroom teachers are faced with a renewed goal of meeting the individualistic needs of all their students. To establish a programmatic base from which they can operate, there is the necessity of understanding some of the background behind these new class participants.

Disturbances in conceptual, motor, social and intellectual behavior have been among the symptoms first noted in the identification of special needs students. Initially, these symptoms are frequently discovered during the early stages of an individual's educational life. Despite the numerous studies and methodologies developed in the fields of education for the special needs student, there is still considerable uncertainty by professionals as to the precise techniques that should be designed for these individuals. This is particularly apparent in the development of experimental-based programs and activities at the elementary grades.

Therefore, the purpose of this paper is to discuss and identify the concepts of concrete and pragmatic methodologies that can be used, via constructional activities, in the teaching of career concepts to special needs students.

CONCRETE THINKING vs. ABSTRACT THINKING

It is an accepted theory that children of elementary school age, especially those with any learning difficulties, tend to grasp ideas which are explicitly expressed in concrete terms. Thus, special needs students have a definite deficit in abstract thinking. The deficit can be easily explained in the following examples:

> The student can use a saw to cut a piece of lumber, but is unable to demonstrate how to use the saw properly without a piece of lumber to saw.
>
> A student can use a rule to measure off distances down to eighths of an inch, but cannot state whether or not 3/4 inch is greater or less than 1/2 inch.
>
> Another student cannot demonstrate how to paint with just a paint brush and not paint, whereas he would be able to paint a surface given all the necessary supplies and equipment.

Researchers have suggested that the essential deficit in some special needs students is their inability to translate precepts and relationships into words — when an activity requires students to interpret a rule or procedure, they will be at a definite disadvantage. However, when an activity involves either recognition of a tool or operation that has been seen previously or the acquisition of a motor or manipulative procedure, the relative disadvantage should not be observable.

Concrete responses, on the part of normal students, may be a secondary and necessary reaction but are developed by the special needs individual as a primary response to establish some form of success. Since the nature and design of our education programs are primarily designed for abstract responses, students who are unable to function in such an environment will either retreat from it or disrupt it; thus the need to experience success is of primary concern to the student. Due to the fact that these students have difficulty in generalizing from one activity to another similar activity, it is imperative that every opportunity is given the individual to express himself in any concrete manner that would allow accomplishment of the tasks involved in the activity.

When the problems of generalization are transferred to constructional activities, it is possible to observe the difficulties that students may have in distinguishing differences between crosscutting and ripping operations or drilling and countersinking. To gain a complete understanding of similar activities or experiences, planning must be carried out to give students the time to practice these activities in as many different contexts as possible. When one considers other problems such as inhibition, motivation and attention, it is easy to see why learning is such a problem for these students.

Contrary to popular opinion, once the special needs student has mastered an activity, his chances of remembering it are the same as the normal student — again, provided he has the opportunity to use the skills and information acquired. Practically, there are two methodologies that can be used in providing instruction to the special needs student. First the teacher should use concrete objects and experiences rather than words alone, and second, the teacher should deliberately broaden the types of activities for the student and associate them with each other as well as with related processes.

LEARNING SKILLS

Prior to delivering instruction to the special needs student, it is essential that the teacher become aware of activity prerequisites which are necessary for the acquisition of looking, listening, moving, motor imitations, chores and self-help skills. These skills can be closely correlated with the types of constructional activities used at the primary levels of education development. Listed below are those behaviors that must be learned before a teacher can successfully teach the student various constructional processes and activities. These prerequisites have been identified by Kozloff as being only three of seven major areas of skill development necessary for successful progression through our educational system. (Kozloff, 1974. pp. 84-85)

Before a student can develop looking, listening and moving skills, he must first learn:

1. To develop spontaneous eye contact.
2. To develop eye contact on request.
3. To cooperate with simple spoken requests.
4. To sit long enough to be rewarded for working at a task.

Before a student can develop motor imitation skills, he must first learn:

1. To develop spontaneous eye contact.
2. To develop eye contact on request.
3. To cooperate with simple spoken requests.
4. To develop skill at many largemotor activities (gross motor movements).
5. To look at objects, parts of the body, face, etc.
6. To develop skill at many small motor activities.
7. To develop good work habits such as sitting, listening and working.
8. To use eye contact to get natural rewards.

Before a student can develop chores (tasks) and self-help skills, he must first learn:

1. To develop spontaneous eye contact.
2. To develop eye contact on request.
3. To cooperate with simple spoken requests.
4. To look at objects, parts of the body, face, etc.

Once the student has acquired the above prerequisites, it will be possible to provide meaningful instruction for the learning of constructional activity skills. The sequence of

instruction that would lead to the acquisition of the skills are as follows: Matching objects, identifying objects by name and motor imitation.

Matching objects is the process by which the student learns to see and distinguish similarities and differences between various objects and/or processes. Upon successful attainment of matching objects, the student should be able to point to similar and different objects, colors and processes.

Matching is a term meaning the ability to see how objects are the same or different. In the process of teaching matching objects, the teacher should also refer to the objects and/or processes by name. If the student can differentiate between similar and different objects when they are named, it can then be surmised that he has learned the names. Thus, the student is capable of identifying objects by name.

The process of teaching motor imitation is quite straightforward. The concept involved is to teach the student to move his body and parts of the body in the same way you do, immediately following your movements. In essence, the teacher's movements become the model for the student to follow. At first, the student should be taught to imitate the teacher immediately following the demonstration, after which imitation should follow after greater lengths of time until fully mastered.

SYMBOL APPROACH

To greatly aid in the successful acquirement of these activity skills, the symbolized approach can be used. This approach provides the learner with visual stimulus (color cutout of tool or material) in sequence of operation to task completion.

To develop the symbol approach, the first step is to break the selected activity down into small sequential steps that can be symbolized by a tool, material or operation.

Second, a set of laminated posterboard tools and materials approximately one-fourth scale need to be made. For ease of identification, the handles of the tools are painted a coded color and the symbolized tools are the same color as the real tool handles. This color coding aids students who are having trouble making the proper tool selection. They can look for both tool shape and tool color and greatly enhance the probability of successful tool selection plus strengthen object identification skills.

To display these symbols, a piece of sheetmetal can be framed and painted; the size is dependent on your specific need. Small magnets are attached to the back of the symbols, and they are ready for display on the magnetic signboard.

Third, an activity sheet should be drawn up that will match the symbol layout on the signboard. This sheet is distributed to all members of the class to aid in reducing the level of abstraction.

Several advantages of this approach:

As previously mentioned:

1. It aids in proper tool selection.
2. It enhances successful activity completion.

In addition:

3. The teacher is freed from repeated explanations so that he/she can move about the activity area to help with individual problems.
4. The students develop a feeling of self-direction.
5. Self-satisfaction is increased through this approach.

All constructional activities can be set up on this approach if some time is spent in selecting activities that lend themselves to this unique classroom setting. To select constructional activities that are both appropriate and beneficial, a criteria list should be reviewed. This list should include the following:

1. Appeal to students.
2. Require few operations.
3. Use gross motor skills.
4. Be inexpensive.
5. Fit into the curriculum.
6. Be able to complete in one or two work sessions.
7. Be easily symbolized.

8. Provide experiences for outside school use, i.e., hobbies.
9. Provide career orientation.
10. Aid in the discovery of aptitudes and abilities.

Constructional activities in the learning world of the handicapped student have an effect that in reality can never be totally measured, but the effects can be observed. The observable effects, plus the inward results, can serve to better prepare that learner as he/she goes through the educational process. Special needs students have the same needs, wants and desires that the world in total has; and through the providing of experiences such as has been described here, we as teachers can aid in the process of helping these individuals become contributing members of our society.

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Minneapolis, Minn., Elementary School Technology Center

Sterling Peterson

The Technology Center consists of an area within the elementary school which involves students in industrial arts (manufacturing), marketing (sales), home economics (consumerism) and office experiences. Students in the program are given lifelike experiences by following a product from its inception until it reaches the hands of the consumer, which involves production, operating costs, distribution, problemsolving, etc. that takes place. The relationship of these four pillars of the world of work becomes obvious to students.

PROGRAM GOALS

1. To provide hands-on experience in a variety of worthwhile activities that generally fall into categories recognized as most needed in the world of work and to provide activities which would develop psychomotor skills.
2. To provide students with consumer exploration. Students must be made aware of and have an ability to choose wisely the goods which they consume.
3. To provide students with safety education. Safety is the responsibility of all people. Children must be trained at the earliest stages of their technical awareness the safe and proper use of tools, simple machinery and appliances.
4. To provide students with an understanding of how technology affects our environment.
5. To provide students with practical experience which would require them to use their basic skills.
6. To provide students with an understanding of our free enterprise system and occupational awareness.

STAFFING

Approximately 60 students per hour work in the Technology Center. To manage this many students, one industrial arts teacher and one home economics teacher are needed. They are assisted by two aides. One aide has a business background and the other has a distribution background.

SUGGESTED EQUIPMENT FOR EACH AREA

Consumerism Area	
ranges	4 free
sinks and cabinets	3 built-in
sewing machines	3
refrigerator-freezer	1
trapezoidal tables	10
demonstration table	1
chairs	30
washer-dryer	1
ironing board	1
dishwasher	1
circular tables	4

Manufacturing Area	
vertical lumber racks	2
storage cabinets	5
buffer	1
uniplane	1
belt and disc sander	1
storage racks	36 feet
air compressor	1
grinder	1
tool cabinet	1
benches	4
finishing bench	1
demonstration bench	1
dust collector, built-in	1
wash area, built-in	1
spray booth, tentative built-in	
circle saw	1
drill presses	2
scroll saws	3

Office Occupations Area	
typewriters, electric	2
typewriters, manual	8
adding machines	3
calculators	2
tape recorders	2
ditto machine	1
storage cabinets	2
file cabinets, 2-drawer	3
desks	16
chairs	16

Marketing Area	
aisle counter	1
cash register	1
counters	4
display shelves	16 feet
mannequins	1 set
mirror	1
hanging rack	4 feet
sign press	1
register stand	1
storage cabinet	1
darkroom sink	1
workbench	1

SAMPLE LESSONS

Two sample lessons from the manufacturing area of the Technology Center at Lyndale and Lincoln elementary schools follow:

Lesson 1

Concept: Materials

Generalization: Acquainting students with a variety of materials, their source and their maintenance will help them understand their effects on the environment.

Objectives: After a demonstration students will be able to identify materials and their sources.
After a presentation students will be able to select an appropriate finish to be used on the product.
After a presentation students will be able to list what is needed to develop proper management of natural resources.

Learning Activities:

1. Test: Students identify and give source of materials.
2. Students will apply appropriate finishes to their individual products.
3. Following a discussion students individually will develop a flow chart explaining wise management of natural resources.
4. Students prepare skit with dialogue related to proper management of natural resources.

Lesson 2

Concept: Processing

Generalization: When students experience the designing and construction of products, they will develop knowledge of the safe use of tools and machines and the skills needed to operate them.

Objective: After a presentation, students will be able to sketch and construct a prototype of their individual products.

Learning Activities:

1. Students will sketch product ideas.
2. Students will present product ideas to the class to be considered for mass production.
3. Students will build prototypes of product ideas selected by the class.
4. Students will present prototypes to the class to be considered for mass production.

Objective: Having been given a lesson on safety procedures, students will use these procedures while working in the manufacturing area.

Learning Activities:

1. View safety filmstrip.
2. Take safety test.
3. Construct safety posters.
4. Wear safety equipment.

Objective: After a demonstration and experience, students will be able to construct and finish a product.

Learning Activity:

Students will practice skills and procedures in producing the product.

Mr. Peterson is a consultant in Industrial and Vocational Education for the Minneapolis, Minnesota, Public Schools.

Elementary School Industrial Arts—A Synopsis of Programs in Minneapolis Schools

Roger Sandau

This paper is presented in the hope that you and your staff will become interested enough in elementary school industrial arts to pursue the possibility of having it in your school. The rewards to children are great. The ensuing material contains the benefits to children, safety, various models in existence, a list of materials, tools and equipment needed, and how you can receive any help you may need.

WHAT THEY SAY ABOUT ELEMENTARY SCHOOL INDUSTRIAL ARTS

Students:

Because you can make things and keep them for a long time, and I like machines and materials. And I made a stove and a dresser and a letter "M" and a table and a pencil holder and a letter holder and that is why I enjoy it.

I like the power tools to work with.

I like woodworking because I can make things for my mom and make presents for other people. I like all the ideas and tools that we can work with and learn about.

Because you use wood and plastic instead of paper. And then you can paint them if you want to.

Parents:

Both of my children have enjoyed industrial arts because it makes them feel so grown up.

My two boys have really enjoyed industrial arts. I think they like school better because of it. I know they stay after school whenever they can for shop.

Principal

Industrial arts at Pratt School continually ranks among the most popular programs with students, staff and families at Pratt School. The program is a fine example of the kind of integration which allows children to apply the basic skills of math and reading to projects which teach manipulative skills as well. In fact, it is as good an example of the "whole child" approach as can be found. In a warm, caring atmosphere children learn to cooperate, feel good about themselves and use big muscles in the completion of their activities — a fine blend of the cognitive, affective and psychomotor domains.

Elementary teacher:

As a teacher, I think our woodshop is great! Even the parents have commented on how happy they are that their children get this kind of experience. The children are always excited to go and always very proud of what they have built. Our woodshop allows the children to do something completely different from the classroom experience. It is a rare and wonderful chance for elementary children.

BRIEF DESCRIPTION OF THE INDUSTRIAL ARTS PROGRAM AT THE ELEMENTARY SCHOOL LEVEL

The industrial arts program at the elementary school level emphasizes materials and processes. Students work with materials such as wood, metals, plastic and leather, and develop such processes as cutting, bending, forming, shaping, fabrication, fastening, finishing, etc. Safety is a primary concern; safety procedures are taught so that students develop good safety habits. The motivation of students is extremely high because children love to work with tools and machines and as a result, gain the many benefits that are described below:

BENEFITS TO STUDENTS

The same rationale used for any good educational experience can be used for elementary school industrial arts.

1. Students gain in self-confidence because of:
   - The visible success of making something to take home and be proud of.
   - Successful experiences with machines.
2. Students gain social skills through:
   - Cross-age teaching.
   - Cooperation in designing and producing a product.
3. Students gain in language arts and math through:
   - Concrete experiences involving mathematical concepts such as space, shape, weight, balance, symmetry, volume, etc.
   - Concrete experiences involving mathematical operations involved in planning, designing, measuring, and constructing.

— Communication of instructions and designs by speaking/listening and writing/reading.

4. Students gain in science skills through:
   — Observations of qualities of materials and tools.
   — Experiences with the operation of machines.
   — Problem solving.
5. Students gain a broader understanding of careers through:
   — Proper and safe use of materials, tools and equipment.
   — Actual experiences relevant to many kinds of jobs.
   — A model of work which is free from sex stereotyping.
   — Introduction to technology.

SAFETY

Industrial arts programs for elementary students naturally raise the question of safety. That concern is uppermost in the minds of persons setting up and operating such programs, with the result that industrial arts has an excellent safety record. There are probably no more band-aids used in the shop of an elementary school than you use in your home. Students are given instruction in the use of the equipment and are required to wear safety goggles when operating each piece of equipment. No student is expected to operate a machine he or she does not want to operate, and no student is allowed to operate those pieces of equipment (the table saw, for instance) which are considered dangerous. Machines are treated like any other vehicle of instruction, not as strange objects that should be avoided because they might attack without warning.

PROGRAM MODELS

Five models in current use in Minneapolis schools will be discussed: Classroom, prep time, special education, interest centers and technology centers. Variations exist in each of the programs to accommodate individual school differences and needs. Each program utilizes wood as its basic material, although other materials such as plastic, leather, fabrics and metals are sometimes introduced. A large variety of projects are produced including such things as toys, math and other games, home products, classroom aids, cages, experimental equipment, etc. Students are taught the proper and safe methods of using materials, tools and equipment. Suggested tools, equipment, materials, and hints as to how you can begin your program are found at the end of this paper.

CLASSROOM

This model is discussed first because of the ease with which it can be implemented. Either a small area of the classroom can be used or a vacant classroom set up to accommodate a teacher and his or her class. This approach has the advantage of excellent coordination between industrial arts and the other disciplines being taught. It has the disadvantage of lack of skill by many elementary teachers in working with tools and materials. This can be easily corrected by inservice and the use of aides or assistants with tools and skills.

Other advantages of this program are: It can be continually upgraded by additional tools, materials, etc. as they become available or expanded as space becomes available. It can easily be transformed into an interest center, prep-time activity or as a part of the technology center.

A typical setting would include various handtools, scrap materials and a workbench with a couple of vises. Given this setting and the opportunity, students can have a worthwhile successful experience and will produce a wide variety of projects. Going first class is nice but GOING is the most important part of the program.

PREP TIME

This model utilizes industrial arts activities to free classroom teachers for prep time. This approach requires a certified industrial arts teacher, a room large enough to accommodate a complete class and the necessary tools and equipment. Combined with other activities such as physical education, media center, art, pottery, etc., it offers an excellent variety to students.

This model appears to be the easiest to implement because funds are available for prep-time teachers. In order to provide the best possible experience for students, it is recommended that additional help be given to the instructor. There are many ways of doing this, i.e., regular aides, older students, junior or senior high school students, volunteers, NYC students, etc.

Woodworking is the primary activity, but graphics, plastics, metals and leather are also used on occasions. Student motivation and interest are maintained by the wide variety of projects possible with wood and the natural progression from simple projects to the more difficult as skills are obtained.

SPECIAL EDUCATION SCHOOLS

This is the oldest model in operation in Minneapolis. It is set up primarily for special education students with the other students rotating through as time permits. It also requires a certified industrial arts teacher and separate room. It carries the added advantage of state reimbursement of the teacher's salary. For years, special education has recognized the benefits of industrial arts to special students. The kind of hands-on success oriented activities that special education students need is the basis of elementary school industrial arts.

INTEREST CENTERS

The interest center model is a relatively new approach to elementary school industrial arts. The S.E.A. schools have utilized it for the past five years with a great deal of success. Variations of this program do exist in other schools of the city and seem to be gaining in popularity because of its flexibility. Schools that have divided their day into basic skills and activity time have found that industrial arts is one of the most popular activities offered. These schools have also found that they can offer a worthwhile experience with a limited amount of tools, equipment and materials to begin with and then build on them as funds or equipment become available. The additional advantage of an interest center program is that no advanced skills are needed by the instructor if only basic hand tools and relatively safe machines are used such as the drill press, hand sanders, scroll saw, etc. Activities vary from individual projects such as cages, science experiments, math games, to whole class projects such as designing and building a cube. Interest centers function best when the number of students doing the activity can be held to about 12 to 15.

TECHNOLOGY CENTER

The technology center consists of an area within the confines of the elementary complex which involves students in industrial arts (manufacturing), marketing (selling), home economics (consumerism) and office experiences. This model is the most extensive in existence and perhaps involves the greatest effort to establish; however, it has the advantage of offering a total life-like experience to students. Students follow a product from its inception (design) to its conclusion (in the hands of the consumer) with all the production, operating costs, distribution and problem solving that takes place in between.

SETTING UP AN ELEMENTARY SCHOOL INDUSTRIAL ARTS PROGRAM

The cost of equipping each of the models varies tremendously from a few simple hand tools in the classroom to much more sophisticated equipment in the technology center. Rather than go into detail in this paper with each piece of equipment needed in each program, we will deal with general suggestions and helpful hints. A more extensive list of equipment and their costs is available from the Industrial Arts Department, Minneapolis Schools.

HAND TOOLS

Various methods of obtaining hand tools have been used:

1. Have children bring them from home.
2. Use extra tools from junior and senior high schools.
3. Use donations from individuals, companies, P.T.S.A., etc.
4. Purchase as needed.

It is quite surprising how few hand tools are really needed and how many can be purchased for 50 to 100 dollars. When taken care of, tools and equipment will last indefinitely.

MATERIALS

Many of the materials needed are readily available from existing school supplies, tempora paint, brushes, glue, etc. Wood is available from mill works, manufacturing plants, lumber yards, etc. A notice sent home with children usually produces many usable pieces of wood. Also, 50 dollars worth of pine and plywood will last quite some time. However, a regular budget should be established for materials. If the program is valuable enough to have, it should have adequate supplies.

Following is a partial list of materials needed:

Nails, 2D, 3D, Brads, 1", 1-1/4", 1-1/2"
Screws, various sizes
Sandpaper, 80, 100, 150 grit
Screw eyes, small
Brass hooks
Drill bits 1/8", 3/16", 1/4", 5/16"
Dowel rods 1/8", 3/16", 1/4", 5/16"
Wood 1/4", 3/8" plywood, pine, bass
Blades, coping, scroll
Stain and varnish

NOTE: Avoid hard woods such as maple, oak, etc. It is too difficult for young people to drive nails into and to saw, etc.

RECOMMENDED HAND TOOLS

This is a basic list. Numbers of each will vary according to size of room and number of students involved.

Hammers, claw, 13 oz.
Cross cut saw
Coping saws, extra blades
Hand drill
Files, round, half round, square
Screw drivers, various sizes
Pliers
Surforms
Compass
Rulers
Square
Brace, bits 1/2", 3/4", 1"
Adjustable wrench
Vice grip
Tin snips
"C" clamps
Block plane

EQUIPMENT

Equipment is classified in two ways: Those pieces students can use and those for the instructor's use only. Listed below is equipment recommended for students' use and in the order in which these should be purchased:

Benches and vises
Drill press, electric hand drill
Scroll saw, sabre saw
Disc sander and vacuum, orbital sander

Additional equipment for older students' use:

Band saw
Uniplane
Lathe

Equipment for instructor's use:

Table saw
Jointer

FINAL NOTES

Schools that have industrial arts facilities find that they are also a very popular extended day and community school activity. In all surveys taken, parents and students in S.E.A. have continually ranked elementary school industrial arts as one of the most popular activities in the schools. The main emphasis in each program should be student success. It is very important that the student is pleased with what he or she does and, therefore, feels good about himself.

A State Specialist's Role in Promoting Elementary School Technology

James F. Snyder

To develop a statewide program in elementary school industrial arts is not (1) simple, (2) easy or (3) uncomplicated. The task is a long range planned and directed program in West Virginia. The position of the state specialist for industrial arts is that of an expediter and a monitor to help the direction stay on course and to move in incremental steps.

The assistance around our state consists primarily of human resources as funds are usually very limited, especially to develop industrial arts in the elementary schools. The advent of career education has helped, but unless teachers have skills and knowledge found within industrial arts the teachers are very reluctant to involve themselves in another "add-in" situation.

To assist teachers the state specialist offers counties in West Virginia several options to spark their teachers into investing time and self to learn and utilize techniques that expand their capabilities. Once they have the opportunity to use tools and materials, they realize the benefits that can be derived by using the concepts of industrial arts in the classroom. They realize the use of technology as a vehicle to expand the study of social studies, mathematics, science and reading.

The state offered opportunities range from long term workshops, curriculum development sessions, short term workshops and conferences. The specialist has conducted workshops in activity center development, mathematics and industrial arts activities in metric and the Annual Elementary School Technology Conference.

The above programs give teachers and administrators opportunities to become involved in tool usage, material development and idea generation. The workshops relieve fears teachers have about tool usage. Older as well as younger teachers realize they can and do use tools they were refusing to even pick up. As teachers realize the fruits of their progress, they become proud and willing to try and use tools and materials in their classrooms. Often, after these sessions, teachers will communicate with the state specialist the activities they have included in their programs.

The Elementary School Technology Conference provides teachers with ideas and an awareness of programs that are available and being used with children. Such programs that have been presented are The Printing Activity Center, New York; Technological Exploratorium K-6, Hudson, Ohio; Technology for Children, New Jersey; as well as Aviation in Elementary School; Self Identification Through Technology; Exceptional Children and Technology and many others. The programs demonstrate interdisciplinary association with science, reading, measurement, social problems, technical developments in society, mass production and careers.

The development of a state program is slow and sometimes very difficult. However, the colleges and universities are expanding their curriculum to give preservice to training teachers. West Virginia is presently encouraging college students to enroll in industrial arts courses to develop their skills, thus providing the state with prepared teachers. Time and patience will render results in our schools.

Mr. Snyder is the curriculum development specialist for Industrial Arts with the West Virginia Department of Education, Charleston, W.Va.

Developing Learning Centers for Teaching Industry in the Elementary School

William E. West

The development of the elementary industrial arts course at Clemson University is ›oted in the historic development of the College of Education of the university. Yes, ,lemson University is indeed approaching the 100th year of service to South Carolina and the United States. However, the College of Education has experienced many births and rebirths in the first 100 years of the university. The most recent rebirth of the College of Education occurred in 1965 when the then existing departments of: Agriculture Education (College of Agriculture), Industrial Education (College of Engineering), U.S. Army R.O.T.C., and U.S. Air Force R.O.T.C. were regrouped into a new college and the following two new departments were created: Department of Elementary and Secondary Education and Department of Recreational and Parks Administration. In 1973 the Department of Recreational and Parks Administration was reassigned to create a new college and thus create the current lineup of administrative units in the College of Education.

The College of Education at Clemson University has experienced tremendous growth from its beginning in 1965. The initial enrollment carried forward in industrial and agriculture education was soon supplemented by increased declared majors in R.P.A. and elementary and secondary education. During the past ten years the College of Education has grown to envelope nearly 19 percent of the total university enrollment. The Elementary and Secondary Education Department has been the principal contributor to this growth.

The formation of the Department of Elementary and Secondary Education at Clemson resulted in an exploratory course in industrial education being included in the program of study for early childhood, special education and elementary education majors. The industrial education course while entitled "Arts and Crafts for the Elementary Teacher" was conceived to service two purposes:

1. To satisfy requirements in state certification for art courses.
2. To provide interface between various elements of the College of Education.

The initial course efforts were pointed strongly toward skill development in tool use and material selection. However, student acceptance as reflected by enrollment was not positive, for many elementary majors were avoiding the course.

In 1969 the Arts and Crafts for Elementary Teachers course was redirected. The restructured course was directed to place strong emphasis on the utilitarian nature of man's knowledge. The course retained a strong arts and crafts orientation in terms of laboratory experience; but class lectures, outside readings and special class assignments were directed to building within the teacher competencies for coping with knowledge of industry. The primary purpose of the course thus moved from mastery of tools and materials usually associated with industrial arts activities to that of acquiring skills and industrial knowledge which would influence learning experiences in the elementary classroom.

The redesigned elementary arts and crafts course has been well received. Enrollment in Industrial Education 372 has increased from 19 elementary-early childhood majors during the first semester 1969/70 to 126 in the first semester 1975/76. While I would like to think that the growth in enrollment and interest reflects an equal growth in teaching excellency, it just is not true. The total enrollment in the College of Education has increased and therefore contributed to this growth. However, the increased course enrollment totals do exceed the Department of Elementary and Secondary Education percent of growth. The actual percent of growth in the arts and crafts course indicates that all elementary, special needs and early childhood education majors are enrolling and completing the course. Thus the opportunity to influence the ability of all such majors to teach about modern industry is afforded our department.

The initial success of the course, at least from future teacher acceptance of the course content, created considerable interest. The success has been sustained over the past 3 years, and during this time student survey information indicates that skills and information acquired have been useful in the elementary classroom.

Three major goa! were developed and employed to develop the course structure of the basic course. Th--- were:

1. All students would exhibit basic skills in performing manipulative activity.
2. The development of positive attitudes toward industrial practices and activity oriented instructional programs would be a focal point.
3. Exhibited skill in the development of instructional units incorporating manipulative practices relating to industrial knowledge.

To achieve these goals the instructional staff did find that goal two was most important. Students who did exhibit success toward goal two were most likely to also exhibit growth toward achieving goals one and three.

The industrial education arts and crafts for elementary teacher course has moved more and more to individualized instructional programming. Necessary instruction relating to required laboratory experiences is designed to be individual modules. Laboratory experience instruction has been built around self instructional media, printed learning activity sheets and small group or individual demonstrations. All students have not followed the same learning sequence. However, each of the students has exhibited growth in knowledge of practices of man relating to the production of material goods.

An outgrowth of the basic course in industrial practices designed for the elementary teacher has been a growing interest to complete additional learning experiences in the industrial arts instructional area. The interest has resulted in growing enrollments in the individual studies courses. The majority of these individual studies' enrollees express the desire to acquire greater knowledge of designing and performing activity-oriented instruction. This interest in additional work in elementary education has taken a variety of instructional approaches.

The work that some of our elementary education students have produced in the development of learning center modules has been most rewarding. The development of learning centers, while not new to the educational format of elementary education, has been given new emphasis during the past decade. The renewed interest in learning centers has created huge amounts of printed material, usually from commercial suppliers. Typically the learning centers have been employing material of a highly cognitive nature. The students at Clemson have attempted to develop learning center material that provides for psychomotor and affective development as well as cognitive growth. The psychomotor dimension of the learning center material is aided by:

1. Creating avenues for applying previously learned cognitive skills in order to achieve higher-than-lower mastery.
2. Developing systems for applying previously learned psychomotor skills in order to develop need for acquiring additional cognitive skills.
3. Providing avenues for rewarding achievement in the cognitive domain and/or the affective domain, yet allowing review and added skill building in these skill areas.
4. Concentrating on existing curriculum components of the elementary school to provide avenues for developing skill in using knowledge.

The learning center modules have been structured to be used in: Arithmetic Learning Centers, Reading Learning Centers, Art Learning Centers, Science Learning Centers, Health Learning Centers and Social Studies Learning Centers.

The modules have been developed to strengthen each of the achievement areas of the elementary schools. Modules in industrial arts for reading improvement have been structured to provide remediation (of particular success with children who are 7 to 10 years of age, yet are reading 1 to 3 years below grade level), sustainment of reading progress and goal enhancement for students reading above grade level. The difficulty of the activity incorporated in the learning center module has been viewed on a two-dimensional scale:

1. Level of subject area achievement (mathematics, reading, science, art, etc.).
2. Level of industrial knowledge presented.

The information regarding dimension one (subject area achievement) has been derived from classroom teacher recommendation and normal testing procedures. The determination of criteria for dimension two (industrial knowledge) has varied from student to student. However, the past year would indicate that students using the structure for industrial knowledge developed in "The Rationale and Structure for Industrial Arts Subject Matter" have greater satisfaction with the learning center modules than do students using less structured formats.

The learning center modules have been developed using a variety of presentation formats. Due to the great variety of elementary classrooms visited and used for development fieldwork, this variety was expected. The general format for development included three element essentials: Specified behavior goals, encoding adaptability and student activity reflecting industrial knowledge.

The specified behavior goals are directed toward assisting the teacher preplan individualized student use of learning centers. The goals have typically referred to cognitive skill level development in one of the elementary school subject areas. The behavior goals have tended to be generated in terms of increased reading, arithmetical and vocabulary skills.

The problem of encoding adaptability has been most difficult to resolve. Students in the elementary school possess a wide range of decoding abilities. Three principal encoding methods have been used with varying degrees of success: Printed words, picture stories and picture stories with audiotape. Experience has indicated that picture stories work very well with most kindergarten and lower elementary grade students. As the student's reading level improves all three encoding methods seem to work with similar student acceptance.

The learning center modules developed during the past year have incorporated activities that elementary teachers have employed previously. The community helpers' theme (with activities relating to producing items used in the home or providing services experienced because of home activity or topics requiring value and attitude development based on home) has high frequency scores in early childhood learning center modules. Activities that build upon and enhance arithmetic skills, science information or social studies topics have been used by the elementary education majors. The creation of weather information gathering devices, geometric construction gadgetry and items of historic significance have been incorporated into manipulative practices oriented learning center modules. However, other learning center modules have been designed around the industrial practices relating to management and personnel. These modules do not require the creation of material objects, but they do require the application of knowledge to solve industrial problems. Puzzles, games, mind tinglers and picture completion activities have each served to develop skill in applying industrial information.

In summary, the efforts to produce learning center modules that incorporate knowledge of industry into learning material have been successful. Students who have developed the learning materials for instruction experienced the problems of creating learning situations. Their experiences should result in a greater awareness of the teacher's role in tomorrow's classroom.

Dr. West is a member of the faculty at Clemson University, Clemson, S.C.

ACIAS Special Interest Sessions American Council of Industrial Arts Supervisors

Energy Crisis: A Need To Mobilize Industrial, Scientific and Educational Communities

Vahan V. Basmajian

The energy crisis of 1973-74 brought to the attention of the world that industrial nations are heavily dependent on energy. The limited resources available are being consumed rapidly. The consequences of this are very critical to our economic and political system. Over the next decade educational institutes with their administrators shall play a major role in introducing an awareness of energy and power to students of all ages and levels.

The solution to the energy shortage will require more than a 100 billion dollar investment and will depend upon the services and the contributions of more than 100,000 engineers, scientists, technicians and skilled workers. Such a massive effort will possibly make the U.S. energy independent from foreign countries by the year 2000.

Educational institutes which play the largest role in bringing changes to society have a great need for the services of the scientific, industrial, governmental and private sources. A systems approach is indicated for bridging the gap between national goals and educational preparedness.

Mr. Basmajian is vice president of the National Educational Council on Energy and Power and president of Megatech Corporation, Billerica, Mass.

Middle School Industrial Arts

John E. Bonfadini

Industrial arts should be a part of the learning experiences of all students at all levels of ability, in order that they may understand and learn to control their industrial-technological environment. These programs should provide opportunities for experiences that develop insights into the broad aspects of industry such as construction, communications and research. Meaningful activities designed to acquaint students with laboratory procedures of creating, experimenting, designing, inventing, constructing and operating are a necessary part of general education. Each course should include instructional information in the following six areas of industrial arts: Orientation, materials, processes, equipment, tools and facilities, production and occupational information.

Prince William County, Va., adheres to this philosophy by offering industrial arts to students at the middle and senior high level. Required courses at the sixth, seventh and eighth grades provide opportunities for students to explore many industrial areas. Students are rotated through laboratories designed to acquaint them with the material areas of plastics, metals, power mechanics, graphics and drawing, wood and electricity.

Industrial arts deals with the principles and concepts of industry including industrial production and servicing, methods of construction, application of mechanism, influence of automation, mass production and fundamental processes and methods of industrial research.

Students electing programs beyond the ninth grade may elect a unit or general lab program. This method permits the student to study in general or specific areas which will meet his future educational-occupational needs. The program also provides certain technical skills, guidance, and basic knowledges necessary to most occupations and professions. Specific programs offered are: Manufacturing, construction, power and transportation and communications.

MIDDLE SCHOOL PROGRAM

Prince William County's middle school industrial arts program is designed to provide unique student experience and activities related to the World of Technology as a required program for all boys and girls. The curriculum format should stimulate student interest in the many possible technical and educational careers associated with an industrial society. For convenience, the program is divided into three 12-week segments beginning with sixth grade. Each segment provides the student with an opportunity to deal with sequential experiences that lead toward a total understanding of technology in today's society.

The sixth grade students first experience industrial arts as a part of the manufacturing processes. They learn to conduct experiments and build products relating to various materials, processes and machines used to shape and form materials into useable products. The small unipac unit is utilized to accomplish this goal in areas of communications, production, and power and energy.

The seventh grade segment, through the utilization of graphic communications and the group or unit method, attempts to provide a means for studying technology and its evolution. The unit or group project permits the students to work through a systematic approach of problem solving related to industry and technology. Through investigating and building models of technical devices that have changed society, students better understand the role of tools and machines since the beginning of time and their present influence upon the society.

The eighth grade segment of 12 weeks emphasizes the power and transportation aspect of technology with students exploring electricity and power mechanics as a cohesive technological unit. Line production, a fundamental concept in all industries today, is an activity utilized to reinforce the students' awareness of industrial procedures. The students are encouraged to establish a company for designing and producing a product capable of realizing a profit.

The middle school curriculum is not designed to be preparatory for a high school program, but is a total separate entity which can provide for future intelligent occupational and educational choices.

SIXTH GRADE PROGRAM

The 12-week segment of industrial arts in the sixth grade is specifically designed to introduce the students to the various manufacturing processes and tools and machines utilized in industry. The vehicle for accomplishing this is the individual unipac. These individualized packages are designed to provide the student with a chance to explore many and various manufacturing processes at his own individual pace. The time element associated with each individual packet is approximately 3 days to 1 week. Emphasis is placed upon understanding the processes rather than the technical skills required for project completion. The following is an example of activities for one such lesson:

A. Activity: Screen-process t-shirts
B. Manufacturing processes involved:
   1. Design and layout
   2. Printing
C. Objectives:
   1. To learn the basic principles of design
   2. To learn the procedures involved with screen-process printing.
   3. To be able to identify commercial applications of screen-process printing.
D. Equipment:
   1. Silkscreen frame
   2. Stencil knives
   3. Drawing instruments

E. Materials:
   1. Water-base stencil film
   2. Textile ink
   3. Turpentine
   4. Water
   5. Rags
   6. T-shirts
   7. Drawing paper

F. Procedure:
   1. Each student will prepare two designs to submit for selection by the entire class.
   2. Class will vote for one design to be printed on t-shirts.
   3. Instructor will demonstrate the following:
      a. Cutting the stencil
      b. Adhering the stencil
      c. Blocking out around stencil
      d. Printing
   4. Each student will print his own t-shirt.
   5. Instructor will demonstrate clean-up and removal of stencil.

G. Discussion:
   1. Identify products printed by the screen-process method.
   2. Discuss the advantages and disadvantages of this process.

SEVENTH GRADE PROGRAM

The seventh grade program synthesizes the manufacturing processes reviewed in the sixth grade into a study of the technological development of man. The Maryland Plan is used as a vehicle for the students involved.

Anthropological Unit

The anthropological unit consists of studying large areas of technological development such as transportation, communications, weapons, tools and inventions. The class of students select one of these topics and individual students select subtopics under the main heading upon which to do research and build a scale model. The building of the scale model incorporates the utilization of the industrial arts tools and machines and laboratory environment. Upon completion of the individual models, a class seminar is conducted to discuss the aspects of these specific technological ideas of man and society.

Product Unit Approach

The product unit approach utilizes the same basic format as the anthropological unit; however, the emphasis is placed upon industrial processes rather than historical development.

In studying these processes, the class selects a category of products such as toys, games, containers, tools, jewelry or housewares. Subtopics of interest are selected by individual students. After this product selection has been made, the student is involved in a series of processes that eventually culminates in a finished product and presentation to the class.

A typical main topic and subtopics of products could be as follows:

I. Containers

a. Cups	e. Glasses
b. Storage boxes	f. Serving tray
c. Plant pots	g. Napkin holder
d. Ash tray	h. Candy dish

Group Approach

Many activities are conducive to group work and often provide the procedures and techniques impossible to develop in any other student activity. Group projects may vary from studies of various industries to group developed products. Group sizes should stem from the project needs. Some projects may successfully function with a small group while other activities may require participation from the entire class. Combining the group projects with the cultural or individual project approach can produce interesting

results. Developing a display for depicting travel methods which were studied in the transportation phase of cultural approach is an example of combining approaches. The group method should appear in at least one area of a middle school program.

The seventh grade also provides the student with an opportunity to explore the graphic communication aspect of the communications industry. The second element of the communications area, electrical communications, is covered in the eighth grade 12 weeks.

EIGHTH GRADE

Line and Mass Production

Mass production is the vehicle used to develop group participation and cooperation. Group cooperation is essential because each operation is dependent upon a previous one. This requires the development of a sense of organization and systematic procedure.

Because industry is such a dominant element in our society, each student needs an awareness of the methods of industrial production. Mass production is just one of the basic methods of producing a product. Based upon class ability, the mass production project may be student-teacher centered or teacher oriented. A brief outline follows:

I. Introduction to mass approach

- A. Historical significance
- B. Relationship to industry
- C. Cultural and economic benefits

II. Planning procedure

- A. Selection of product
- B. Establishment of management programs
- C. Training production workers
- D. Development of prototype
- E. Production session
- F. Sales programs
- G. Evaluation

Responsibility for demonstrating the safe operation of all equipment lies with the instructor. This can be accomplished during the initial planning and design phase. The class elects a project supervisor and other key personnel such as production manager, safety engineer, sales manager, design engineer and procurement director. Responsibilities for completing specific operations are assigned to each student or groups of students.

Power and Energy

Electricity and power mechanics are utilized as the two instructional areas for student participation in activities associated with the World of Energy. These areas provide students with an opportunity to do both experimental type activities and maintenance and repair work. Systematic procedures can also be developed in recording and analyzing data. Electronic projects, small gasoline engines and experimental kits are the basic modes incorporated in this instructional block of time.

CAREER EDUCATION

Each segment of the middle school program also emphasizes specific careers. The careers are limited to those that can best be exemplified by the actual student activities conducted in the industrial laboratory.

Mr. Bonfadini is supervisor of vocational education for the Prince William County Schools, Manassas, Va.

Elementary Industrial Arts—Philosophies, Values and Typical Programs

F. Milton Miller

This presentation is divided into the following three parts: Five major philosophies of elementary school industrial arts, eight values to be derived by children who experience an elementary school industrial arts program and examples of typical programs in elementary school industrial arts today.

The program of industrial arts as it exists in the elementary school classroom of the 1970's is the product of an evolutionary process through which elementary and industrial arts educators have attempted to interpret the philosophy of many of the early proponents of the activity-centered school. As a result a multifaceted program of elementary school industrial arts has evolved.

MAJOR PHILOSOPHIES

The myriad of programs which currently exist can be categorized into five major groups based on the primary purpose which the program seeks to serve:

1. Industrial Arts as a means of developing habits, attitudes, problem-solving, and interests.
2. Industrial Arts designed to meet developmental needs of children.
3. Industrial Arts as a program involving students in making objects for the inherent value of the objects themselves.
4. Industrial Arts as a vehicle through which children acquire occupational awareness.
5. Industrial Arts as a means of correlating and enriching the elementary curriculum.

VALUES OR BENEFITS

Some of the most relevant values or benefits to be derived by children who experience a program of elementary school industrial arts are:

1. Providing a means for satisfying the needs young children have to build, to construct, and to express themselves creatively. When children achieve success in a tangible form they build confidence and acquire a measure of self-realization.
2. Clarifying, enriching and broadening of concepts through first-hand experiences. The teacher is able to bring several of the senses to bear in a given learning situation, increasing the effectiveness of the learning situation.
3. Applying knowledge in a natural and realistic setting. The activities of planning, measuring, calculating, describing, drawing, designing and others inherent in construction must utilize facts and skills gained in other phases of the elementary curriculum.
4. Developing an increased desire or drive to learn. Children may be highly motivated to read, to discuss and to secure information needed to construct things that will be put to immediate use.
5. Developing problem-solving skills. Constructional activities give a realistic flavor to problem-solving which makes it meaningful to young children.
6. Producing three-dimensional objects for observation and for use in dramatic plays.
7. Increasing understanding of the ways in which industry and technology affect the production of consumer goods. Through direct study of and experience with constructional processes, the child can better comprehend the processes of industrial production as well as materials of production. The "world of work" takes on a broader and more realistic meaning.
8. Development of certain behaviors, attitudes, and appreciations that have no direct relationship to the object being constructed. For example, to stick to a task until it is finished, to put tools and materials away for later use, to accept and profit from suggestions, and to assume responsibilities for a task that is important to the gro as well as to the individual.

CAREER EDUCATION

The present emphasis on career education by contemporary educational leaders provides a natural frame of reference for elementary school industrial arts. The multi-

faceted program of elementary school industrial arts seeks to achieve many of the same goals which have been specified for career education at the elementary school level. Career education at the elementary level is an effort to help children emerge from the world of fantasy about work toward the reality of understanding themselves and the nature of their future life's work. It is a time for building career awareness. Elementary school industrial arts activities provide experiences that make learning relevant by illustrating ways in which people use work for self-support and self-respect, means by which job tasks are accomplished, and the relationship of productivity to a variety of occupations. A variety of ways in which people prepare for jobs should be examined to reveal the role school subjects play in helping people become occupationally competent.

To identify the tools, materials and construction activities that can best be utilized in developing "career awareness," a national research project was undertaken at the University of Missouri—Columbia to study 20 career education programs that utilized constructional activities. The study was designed to isolate those tools, materials and construction activities that had proven to be most effective.

Data gathered from the tool information form revealed 212 different tools were being used in the various projects. There were 27 tools that were used by more than 50 percent of the projects. The tools were placed into categories as follows:

MEASURING AND LAYOUT

Yard sticks	Bench rule	Framing square	Try-square

CUTTING TOOLS

Cross-cut saw	Half-round file	Hack saw
Back saw	X-acto knife	Tin snips
Block plane	Hole punch	Scissors

DRILLING AND BORING

Hand drill	Bits	Brace	Auger bits

ASSEMBLY

Wooden mallet	Screwdrivers (regular and phillips)
Claw hammer (7 and 13 oz.)	Slip-joint pliers
C-clamps	Portable tool carts

The material utilization instrument indicated there were 251 different materials being utilized with 14 being used by more than 50 percent of the projects. The materials were placed in the following categories:

WOOD

Fir plywood	Pine	Dowel rods

PAPER PRODUCTS

Drawing paper	Masking tape	Poster board

ASSEMBLING

Rubber cement	Common nails	Finish nails

FINISHING

Latex paint	Paint brushes	Abrasive paper

OTHER

Coping saw blades	Wool yarn

Construction activities listed by the various projects ranged from the construction of miniature gas-powered rockets to growth charts. Selected examples from the various projects include:

Mass-production of bird houses	Making of paper
Development of power systems	Letter holders
Post office	Riverboats
Tangram puzzles	Tic-tac-toe game
Model cities	Bumper stickers

It can be concluded from this and other investigations that a great variety of hands-on construction activities are being carried out at the elementary school level with a high degree of success with a minimum expenditure in tools and materials.

I believe that elementary school industrial arts will continue to expand as teachers and administrators seek ways to meet the needs of the individual students.

Dr. Miller is an associate professor of Industrial Education at the University of Missouri, Columbia.

Minneapolis Senior High School Industrial Arts Program and How It Blends into a Vocational Program

Sterling Peterson

The instructional program at the senior high level is a phase of the industrial education continuum K-12 and is organized around clusters which are transportation, manufacturing, communications, construction and the emerging energy cluster. At the elementary and middle school levels, students are given a broad orientation to industry. As they move into senior high school programs, the experiences become more specific. Students explore aspects of a cluster in greater depth and based on these experiences, may decide to enter into a 2-hour block program to gain a marketable skill in a specific occupation giving them the expertise to move into an entry-level position or the articulation needed to apply for advanced standing at a postsecondary institution.

The senior high school program consists of 1-hour a day courses with industrial arts objectives and 2-hour a day courses with trade and industry objectives. Students at the ninth grade level are encouraged to take one-hour a day trimester courses from two or more clusters, e.g., photography, industrial metals, small gasoline engines. During the 10th grade they may elect to explore in depth one of these areas for three trimesters. After they have completed four 1-hour-a-day trimester courses in an occupational area and want more experiences in that area, they must go into a 2-hour-a-day program which is designed to give them a marketable skill. If they do not want to gain a marketable skill in that particular occupation, they are encouraged to take a different 1-hour-a-day sequence of courses. Upon completion of this they would go into a two-hour a day program and gain a marketable skill. This would continue until a student found an occupation he or she would like to pursue.

This type organization will cause an industrial education student either to gain a broad knowledge of industry or a marketable skill. How many times have students spent 4 years in a woodworking program and as a result gain knowledge of only a small fraction of the industrial world and not a marketable skill. In this type program the industrial arts objectives blend into the trade and industry objectives and form an industrial education continuum.

DEVELOPMENT OF PROGRAM

A careful analysis of occupational needs and trends was made and based on this analysis, it was determined that the education program for the Minneapolis Public Schools could provide exploratory experiences and marketable skill preparation in 38 occupations in the five clusters mentioned above.

Contracts were signed with competent instructors who have dual certification (industrial arts degree and a vocational certificate) to make six interviews with knowledgeable people in an occupation to determine what skills should be taught in order to adequately explore or gain a marketable skill in that occupation.

From these task analyses it was determined how many 1-hour-a-day and 2-hour-a-day trimester courses should be written for each occupational area. Again contracts were signed with teachers to write these courses. A very important component of each guide is the performance profile. This profile lists the broad competencies a student will gain in that course. At the conclusion of each course, the student rates his or her-

self as to how well they can handle each competency. Following this, the instructor rates each student. These profiles are then put on microfiche and become available to each student upon call to help the student obtain employment or advanced standing at a post-secondary institution.

As the program was developed, attention was given to the elimination of sex and racial biases and emphasis on the contributions made by various ethnic groups.

As a result of the industrial education continuum K-12, boys and girls have the opportunity to explore industry and if they desire, gain a marketable skill.

Mr. Peterson is consultant in Industrial Arts for the Minneapolis Public Schools, Minneapolis, Minn.

Providing a Statewide Program of Activities for the Texas Industrial Arts Students Association

Alvin A. Seher

Providing a statewide program of activities for the Texas Industrial Arts Students Association (TIASA) begins the first weekend in June at the annual TIASA officers and Advisors State Leadership Conference.

Newly elected state officers of TIASA, along with their advisors, are acquainted with the duties and responsibilities of their office at this time. At the conference, business is conducted and goals are set for the year. The just-completed state competition is evaluated, including a discussion of a number of proposed changes. A unifying theme for the coming year is chosen for local and regional associations and the state association. The TIASA task force (calendar of activities) for the coming school year is finalized and special committee appointments are made.

This leadership conference is held in conjunction with the annual Texas Industrial Arts Association Board of Directors meeting. The state student officers and their advisors meet jointly with the TIAA Board Members for a noon luncheon. At the luncheon introductions are made and the students get a chance to meet, share ideas and express concerns in an informal and relaxed atmosphere.

TIASA organizational packets, which have been previously prepared, are sent in August to schools that participated in the state competition and all affiliated chapters of TIASA. The packets assist advisors in organizing and conducting their local TIASA chapters and in affiliating with the state and national student organization. These packets contain the following material:

1. A list of benefits students receive as members of TIAA and AIASA.
2. Instruction on how to organize local TIASA chapters.
3. Affiliation forms (TIASA and AIASA).
4. TIASA Task Force Activities.
5. TIASA (leadership) Handbook, which contains the Constitution and Bylaws (new chapters only).

September focuses on a membership drive for local chapters using the current year's theme. During the drive local chapters organize and their members get to know each other. They use the TIASA Task Force Activities in planning for the coming school year.

At the first of October, the quarterly TIASA Newsletter is sent to the various TIASA chapters throughout Texas. The newsletter is a publication of, by and for the students of the various TIASA chapters.

The first regional TIASA meeting announcement is mailed out about this time. Texas is divided into eighteen regions which correspond to the approximate boundaries of the regional associations of the Texas Industrial Arts Association. These regional student associations are composed of all active local TIASA chapters within that region which have affiliated with the state association.

Regional meets are held in various times for business purposes and getting acquainted. The following activities take place at regional meets: Officers are elected and installed,

local chapter sweethearts are introduced, the next meeting dates and places are scheduled, leadership development activities take place and recreation and refreshments are offered.

Other regional meetings are based around leadership activities, program development, regional contest preparation, competitive chapter activities, recreation, refreshments and occasionally a local field trip.

In the fall, the TIASA state officers, advisors and advisory committees usually have a meeting. Leadership development for local and regional TIASA members and advisors is planned for the annual February TIASA State Leadership Conference, held in conjunction with the Texas Industrial Arts Association Teachers Conference. Program planning for regional, state and national competition is finalized. New rule changes for the state and regional competition are approved in an all day event involving the students and their advisors. State and national officers are encouraged to visit the various TIASA and TIAA regional meetings throughout the year. The regional meetings provide an opportunity for students and teachers to be active in their organizations.

The executive officers of the TIASA present a program at the annual February Industrial Arts Teachers Conference for vocational directors, industrial arts supervisors, teachers of industrial arts as well as other interested individuals. The officers discuss how to organize and administer TIASA chapters and carry out the leadership program which was planned in October for this meeting.

Also scheduled in February is a general business meeting of the TIASA for local and regional chapter delegates. This is an open business meeting which the TIASA members and advisors can attend. Final plans for the Texas delegation to the national AIASA conference are made as well as final plans for regional and state competition. The TIASA students and their advisors join with the teacher organization for a noon luncheon to close the conference.

Early in March, regional TIASA chapters and advisors meet jointly with the regional industrial arts teachers to plan and prepare for the regional TIASA competition and youth conference. Leadership training, such as that conducted at the state meeting, is carried on at the regional level for those chapters which were unable to attend the state meeting in February.

The Texas delegation to the national AIASA conference is headed by the state president, who is authorized to be the voting delegate by proxy to those AIASA chapters which could not attend the AIASA business meetings.

After the national conference is completed, various TIASA regions hold their student competition in preparation for state competition. The regional sweetheart is elected from local chapter sweethearts. Projects are entered in judging competition. Student participation contests are held, such as written tests in wood, metals and electricity. Other contests include drafting, public speaking and chapter competitions for local chapters. Students and projects that place in regional competition advance to state.

The Governor of Texas proclaims the week of the state meeting as Industrial Arts Week in Texas.

At the state competitions, officers are elected for the coming year, a sweetheart is elected from the regional sweetheart candidates and other association business is transacted. Projects that were regional winners are entered in various categories as presented in the TIASA Rules Handbook. Contest competition is continued. The state competition is usually a two-day event climaxed by an award presentation. State leaders from other youth organizations are asked to bring greetings to the Texas Industrial Arts Students Association. Special guests are recognized along with the guest speakers. Other activities include recognition of student contest winners, project winners, presentation of the TIASA sweethearts and introduction and installation of state officers. The newly elected president-elect of the student organization is presented the gavel and as his first official act declares the meeting adjourned. This climaxes a statewide program of activities for students enrolled in industrial arts and the members of various TIASA chapters.

Mr. Seher is the executive secretary of the Texas Industrial Arts Students Association which is sponsored by the Texas Education Agency, Austin.

Status of Federal Funding

Ralph V. Steeb

This study was conducted jointly by the legislative committees of the Industrial Arts Division of the American Vocational Association and the American Industrial Arts Association. James E. Good, District Supervisor, Greece Central School District, Greece, N.Y. and committee chairman for AIAA, compiled a first report in November 1974. Ralph V. Steeb, State Consultant for Industrial Arts for Florida and committee chairman for the AVA, compiled this report.

The purpose of this report is to provide information on the inclusion of industrial arts in state plans and the actual vocational funding for the fiscal y· ·r ending June 30, 1975, and an update for FY 1976 conducted in March 1976. The da: are reported as submitted by the respondents of the 50 states and Puerto Rico. Because of the many variables among the states including size, policies, procedures and historical structure, comparisons of state data cannot be equated. No attempt should be made to use this material to intimidate or embarrass any individual, organization or state.

SUMMARY REPORT FOR FY 1975

Although Congress included industrial arts in the definition of vocational education in 1972, it was not until December 1973 that the federal regulations became effective. As a result, industrial arts could be included in state plans for vocational education for the first time in FY 1975 (July 1, 1974 – June 30, 1975). This report is therefore a summary of the status of industrial arts after the first full year of eligibility for federal and state vocational funding. In view of this fact, the national trends and progress are positive and encouraging.

A summary of the inclusion of industrial arts in the state plans for FY 1975 and of funding received for each of the 50 states is given below:

38 states have industrial arts in the state plan.
- Of these:
  - 12 states have allocated more than 100,000 dollars to industrial arts,
  - 12 states have allocated from 600 to 100,000 dollars to industrial arts,
  - 4 states received some state vocational funds but no federal vocational funds and
  - 10 states received neither federal nor state vocational funds.

12 states have not included industrial arts in the state plan
- Of these:
  - 4 states received some vocational funds and
  - 8 states received no vocational funds.
  - Two states added industrial arts to their state plan in FY 1976.

Individual state reports are on file at the AIAA national office. Many of the figures are estimates because discrete figures for individual subject areas are not available in certain state accounting systems. To compare state figures is futile. States vary greatly. The number of industrial arts teachers ranges from a couple hundred to more than 5,000. The use of federal vocational funds within each state varies from complete state control of the funds to outright grants to local educational agencies for local decisions. The policies and procedures for the disbursement of these funds follow no common plan. This is to be expected under federal regulations which permit each state to write its own state plan.

This report extends only to vocational funds. General education funds, long the major source of support for industrial arts, are not reported here. Several states which have included industrial arts in their state plans but have allotted no vocational funds for programs are among those which have had a long history of strong state and local funding.

The job titles of the state personnel responsible for industrial arts who responded to the survey questionnaire include 24 different titles. The greatest frequency is for supervisor of Industrial Arts.

TITLES OF STATE PERSONS RESPONSIBLE FOR INDUSTRIAL ARTS

13 Supervisor, Industrial Arts
7 Specialist, Industrial Arts
5 Consultant, Industrial Arts
2 Director, Industrial Arts
2 Supervisor, Trades and Industry and Industrial Arts
2 Supervisor, Industrial Education
1 Supervisor, Industrial Arts and Occupational Programs
1 Supervisor, Industrial Arts and Prevocational Programs
1 Consultant, Industrial Arts and Vocational Handicapped Programs
1 Chief, Industrial Arts
1 Coordinator, Industrial Arts
1 Special Assistant to the Superintendent for Career Education
1 *Career Services and Industrial Arts*
1 Consultant, Career Education, Elementary/Secondary Services
1 Program Chief, Trades and Industry
1 Supervisor, Trades and Industry
1 Consultant, Industrial Education
1 Supervisor, Secondary Vocational Programs
1 Consultant, Secondary School Services
1 Consultant, Industrial Occupations
1 Consultant, Industrial Oriented Occupations
1 Assistant Vocational Director, Industrial Arts
1 Supervisor, Technical Education
1 Specialist, Curriculum Development

This report is optimistic and indicates great progress and notable cooperation over the short period of time since the federal regulations were released. Yet the report does not allude to the related conflict of philosophies between industrial arts and vocational education which had to be resolved by each state. Industrial arts and vocational educators are establishing new relationships as plans are made to fulfill the objectives of the Vocational Education Act.

It is not the intent of this report to draw inferences on the data received. In fact, opinions and information other than funding were not collected. The first status study by James Good carries extensive recommendations for state supervisors, local supervisors, teacher educators, and teachers. The limited extent of this follow-up study precludes recommendations. However, the author believes that continued study and monitoring of the developing status of industrial arts under federal legislation are necessary. Supervision should be examined carefully because control follows funding. Each state must individually resolve its program relationships and standards, remembering that industrial arts should not be limited only to a prerequisite role to vocational programs. Industrial arts goals are broader than vocational education. Its value to pupils includes the occupational objective but also the broad goals necessary to effective living in a technically oriented society.

Mr. Steeb is a consultant for industrial arts, Florida State Department of Education.

Organizing and Implementing a Local Chapter

David R. Stewart

As a faculty advisor for a local industrial arts chapter, I could not begin to tell you all the different ways to organize and implement a local chapter. The possibilities are as varied as the individuals interested in forming an industrial arts chapter. I can only relate to you my personal beliefs and experiences.

You may have many questions about organizing a chapter of the American Industrial Arts Student Association. Probably the first and most important question is: What is

AIASA? Industrial arts clubs are nothing new. They are formed wherever and whenever students become interested about extra curricular activities in industrial arts. Also, they are formed when enthusiastic teachers and supervisors recognize the needs of these students.

Some local clubs exist strictly for social purposes. However, the more progressive and dynamic clubs operate on a service oriented basis or as an informal extension of the industrial arts curriculum. The result of the formation of local clubs is increased interest, enthusiasm and student progress. The AIASA is an organization of local groups and individual students sponsored by the AIAA.

What are the purposes of the association? The general purpose of AIASA is:

> To widen and deepen the interest and knowledge of students in this technological age; to motivate regular school work; to assist individuals in the making of informed and meaningful occupational choices; and to promote industrial arts in the public schools of America.

The specific purposes of the association are:

1. To provide the student with opportunities for the development of leadership in social, civic, school and community activities.
2. To develop through group action the ability of members to plan together, organize and carry out worthy activities and projects.
3. To explore industry and the American industrial civilization.
4. To promote high standards of craftsmanship, scholarship and safety.
5. To foster a deep respect for the dignity of work.
6. To provide good leisure time activities and hobbies.
7. To provide opportunities for wholesome recreation.
8. To encourage students in creative expression.
9. To develop consumer knowledge in students.
10. To instill desirable habits and attitudes toward the American way of life in students.
11. To provide occupational information and instruction pertaining to a broad range of occupations, including training requisites, working conditions, salaries or wages and other relevant information.
12. To provide exploratory experience in shop, laboratories, and observations in business or industry to acquaint students with the occupations.
13. To assist in providing guidance and counseling for students enrolled in industrial arts programs in making informed and meaningful choices in selected occupational fields.
14. To prepare individuals for enrollment in advanced or highly skilled vocational and technical education programs.

The teachers who plan to organize a local chapter need to recognize that in order for the chapter to be successful, the interests of the students must be the center of attention.

Another question that you and students must answer is: What can the chapter offer to the students? In response, with careful organization and planning, the local chapter can provide many opportunities for educational and social activities. Examples of activities include field trips and tours of industrial plants, experimental stations, laboratories and manufacturing facilities. Social functions for a local chapter might include hay rides, seasonal parties, carnivals, ball games, movies and concerts.

Once the purposes and goals of the chapter are recognized, the local group may conduct an organizational meeting. Excellent publicity should be provided well in advance of the meeting. At this time, a student committee to study the constitution, the bylaws and the AIASA handbook should be selected. This committee can then make recommendations to the entire group. After everyone has considered the committee's recommendations, a special meeting should be called to adopt the AIASA Constitution.

The election of officers for the chapter will be an opportunity for all members to become involved and to exercise voting privileges.

Who are the members of a local chapter? Careful consideration must be given to the kind of student that the chapter needs. Quality, rather than quantity, is the number one factor. Students interested in joining the chapter need to be interested in fulfilling the purposes as outlined in the general and specific purposes of AIASA.

Students and advisors will be concerned about financial aspects of the chapter. In our local chapter, dues are assessed each member. The amount of the dues is decided

by the local chapter members based on the budget requirements. Affiliation dues for the state and national associations is the major consideration. Other expenses are covered by various fund raising projects. During the past six months the Lyons Junior High School Chapter conducted the following fundraising projects:

1. Sold chances on a 100-dollar Gift Certificate.
2. Sold homemade candy during breaks at school.
3. Showed three movies at separate times during school and had concessions at these movies.
4. Held a fish fry dinner.
5. Sold Fund's-A-Poppin' Toffee Popcorn.
6. Held a student-faculty basketball game, charged admission and had concessions.
7. Sponsored a bar-b-que chicken dinner.
8. Held a spring carnival with games, concessions and talent.
9. Sold bumper stickers labeled "All The Way To Iowa" to advertise the trip and raise money.
10. Sold tire raffle tickets.
11. Held a Radiothon to raise pledges and donations for the national convention trip.

Through these efforts, students raised over 9,800 dollars. These projects are only examples. You may develop many additional projects. With this money 25 delegates attended the Georgia Industrial Arts Convention. Thirty-nine members and seven adults are in attendance at the AIASA convention this week. I wish that you could visit a local chapter of the AIASA such as Lyons Junior High School Industrial Arts Chapter of Lyons, Ga.

I encourage you to consider organizing a local chapter of AIASA. Your total industrial arts education program will be the richer for it.

Mr. Stewart is a member of the faculty of Lyons Junior High School, Lyons, Ga., and is a member of the American Industrial Arts Student Association Board of Directors.

ACIASAO Special Interest Session American Council of Industrial Arts State Association Officers

State Conference Programming

C. Richard Lanier

The use of the word "conference" is utilized in this presentation deliberately as it provides a more desirable connotation than the often used word "convention." The word "convention" over the years has obtained a negative concept that tends to turn off some people in regard to attending. Also, there are those individuals who frequently grant permission for a number of us to attend functions of this nature who sometimes automatically say no to conventions. It is realized that this is merely a play on words, but it carries with it some serious consequences for some of us when it could mean the difference as to whether or not we are able to attend a worthwhile function. The word conference has a more positive aspect and reputation that tends to be more educationally sound. I realize full well that words are inconsequential and the real import of the matter is obviously the content of state programs. However, it behooves us to explore every consideration at our disposal in the planning of our state conference programs.

This presentation is the culmination of a survey instrument being sent to 45 state associations within the United States and its territories early in March of this year. Out of the 45 organizations contacted, 25 responded providing us with a 56 percent response which is considered by many as a better than average number of respondents in a survey of this nature. In view of my limited experience in state conference programming, I enlisted the aid of the four immediate past presidents and executive director of the Ohio Industrial Arts Association. My experience as program chairperson in the Ohio Industrial Arts Association was interrupted by the national conference being held in Cincinnati in 1975. (Ohio did not have a state conference in 1975.) I didn't really get my feet wet until March 1976, when our state conference was held this year. This was the reason for calling on our past presidents and executive director.

The historical aspects of state associations responding to the survey reveals the earliest formation of a state association took place in the state of Kansas in 1925 and the state of Missouri being the most recent in 1972. The other states responding were organized in the 1930's, 1940's, 1950's and 1960's which gives us good overall representation in the development of state conference programs.

The officer indicated responsible for state conference programming within the state organization was president-elect and president, with others mentioned as follows: State officer and executive director, past president, presidents appointment, convention director, state supervisor and curriculum specialist.

The length of state conferences varied with two days being the most prevalent, followed by three days, one day, and only one association reporting over three days for a state conference.

The number of state organizations that provided for exhibiting of student projects was 12, and only seven of those included judging those student projects. Relative to state organizations having a school exhibits manager, the results were split evenly with 12 having a person in that capacity and the same number of state associations not having a school exhibits manager.

Twenty-two reported the utilization of breakfasts, luncheons and banquets with some being selective in that only one or two of the possibilities were used. Twenty responded indicating the use of speakers as a part of the above functions.

Only 10 states have their industrial arts supervisors meeting as a group during the state conference while 15 did not take advantage of this opportunity.

Fourteen reported their industrial arts teacher education group met during the state conference while 11 elected not to meet as a group during that time.

The number of those with a reporting legislative committee was 13, while there were 12 showing no legislative committee functioning.

It was almost unanimous in attempting to engage speakers on new innovations for state conferences by a 21 to 1 margin. The use of nationally recognized speakers in national trends reveals nineteen using them in their conference with only four not reporting any interest.

Book publishers being invited to present program materials was popular in 17 instances, and eight did not make use of this source.

Speakers on career education prevailed during 18 of the state conferences along with 15 using panel discussions and reactor groups. Demonstration presentations were very popular in 23 of the state conferences.

Only four states have more than one conference, while 19 indicated only one conference during the year and varying in length.

The survey brought to light that only seven states have their conference in the same location each year, while 14 were on a rotational basis among three to five different cities. The most common response for who determined the site selection was the executive committee. The number attending the different conference locations ranged from 125 to 1,000 persons. Eighteen admitted to better attendance of their conference when held in a central location, and only three said their attendance was not any better.

Twenty-two have the same program chairperson for one year and only two for a two-year period. Fifteen elect their officers during an annual business meeting, and 12 elect officers by mail ballot. Fourteen elect their officers for 1 year, and five for a 2-year period.

The selection of a conference theme was prevalent in 20 instances, while only five did not choose a conference theme. The selection of a theme for the state conference in most cases was by a program committee.

Most of the associations provided budgeting for the state conference within the range of 25 to 9,000 dollars with the cost of the most current conference reflecting that same range. The total number of members in attendance varied from a low of 56 and a high of 1,250. Eighteen of the state associations reporting indicated the use of a registration fee for the state conference. The number of sessions indicated were from a low of 1 to a high of 97. Most of the states used a combination of volunteer and solicited presenters and speakers for the conferences. The most common time block used by the presenters was 1 hour, followed closely by 45 minutes, then 30 minutes.

Most of the individual sessions were planned to be compatible with the conference theme. Fifteen state organizations provided remuneration for the presenters in the form of honorarium plus expenses. It was near unanimous in that program chairpersons followed up on presenters with indication of duties and establishing of time slots. A large percentage of the associations made use of hosts, recorders and program chairpersons for the sessions and these responsibilities were accepted by those members solicited and volunteering.

The use of a newsletter to publicize the state conference is widespread. Twenty-one of the 25 respondents indicated the existence of such a vehicle in their state association.

Twenty-three include commercial exhibitors in their conferences and range from 15 to 100 exhibitors for the conference. The size of the commercial exhibitors booths are from 8 by 8 feet to 20 by 20 feet at a cost of from 15 dollars to 200 dollars with the most prevalent cost in the 15 to 45 dollar range. There are 16 state groups that have commercial exhibits managers with varying responsibility.

State associations sponsoring student industrial arts club activities during the state conference are almost split evenly with 13 providing student activities during the conference, while others provide student activities at other times and a few with no provision at all.

In conclusion there are some assumptions that can be made relative to the identifying of characteristics that can be utilized in improving state conference programming. They are as follows:

1) Identify the desires of the membership relative to programming.
2) These desires should be quite diverse.
3) The diversity of desires should require diverse programs.
4) Determine if there are programs the membership may not want, but should have to move the discipline forward.
5) Utilize a back-up speaker in case of no show.
6) Try to determine the program yield or impact relative to cost of program.
7) Determine whether one needs to stay within the state borders or seek leadership from out of state, or combine both alternatives.
8) Determine how the greatest number of persons can be involved.
9) Find out what means can be utilized in getting a representative group to assist in the programming.
10) Consider programs that raise issues and cause controversy.
11) Inform everyone involved in the total conference of all developments to assure a minimum of conflicts.
12) Communicate closely and frequently with the site selected to insure accommodations will be adequate.
13) Start planning the program early.
14) Prepare publicity for the conference.
15) Prepare a rough draft of the program 2 months ahead.
16) Prepare a final draft of program 1 month ahead.
17) Present the program to the printer at least 1 month ahead.
18) Most of all, be on top of the situation. Do your homework !

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ACIATE Special Interest Sessions American Council on Industrial Arts Teacher Education

Planning A Slide Presentation

Eugene Balzer

Effective communication with people is a very complex process. During communication we can encounter many problems. The largest problem is that we forget that people have accumulated different individual experiences. Although we experience the world in small bits and pieces, these pieces and their sequences are different for each person. To communicate with people we have to break the subject down into small pieces.

No matter how simple or complex your communication may be, a special sequence takes place. The source of any message begins in the brain of the sender. The message is then encoded or converted into transmittable forms such as the sound waves of your voice, or musical notes or written words in a script or lesson plan. The message then passes through a transmitter like air, light or paper to the receiver. The receiver picks up the message by senses where the message is decoded. Finally the message reaches the brain of the receiver.

Placing this sequence of events in a classroom situation, you as a teacher have an idea in your mind (source of message) that you want your students to learn. You script the lesson in the form of a slide presentation (message encoded). In the classroom you present the slides (transmission channel) to your students, they watch the presentation (received and decoded) and finally your idea reaches the learner's brain (destination of the message).

Effective communication depends on the receiver being active. He can react by asking questions or by physically performing a task. Ideally he would do what you set as your objective in the lesson. This process is known as feedback.

A stumbling block in communication is noise. Noise is any type of interference that takes place during the transmission of the message. It can be misspelled words, audio noise or any type of disturbance.

Now that we have briefly examined the communication process that takes place, let us look at how we can properly plan a slide presentation for the best possible communication. It is best to start with an objective such as, "After viewing the presentation the learner will be able to...." After stating the objective, an easy and effective way of planning is to record ideas on 4 by 6 inch index cards. On the cards draw a large rectangle in the upper left-hand corner and then add reminders for specific information, illustration numbers, production notes and narration.

Since the visual carries more information in a slide presentation than the narration, sketch the proposed shot in the rectangular space. Now you might think this is a lot of work but it is done in many movies. The latest example is the movie, The Hindenburg. By beginning with the visual you will develop a visually oriented presentation rather than a speech to which slides have to be added.

To add variety to the presentation, you have at your photographic disposal different shooting distances. These types of shots are: Extreme long shots (ELS), long shots (LS), medium shots (MS), medium close-up shots (MCU), close-up shots (CU) and extreme close-up shots (ECU). In addition to the distance the camera is located from the subject, you can also vary the camera angle. These angles are: Eye-level, high-angle and low-angle.. Along with the visual, you may want to write special production notes that are needed when you go out to shoot.

Following the visual portion write the narration for each visual. Specific types of words to exclude from your narration are "This slide shows...." or "In this slide we

see...." You already have the audience's attention, they know it is a slide, so you can begin directly into the narration.

After you have recorded all your ideas and arranged them in the proper sequence, you are ready for production. Although you have the presentation planned, do not limit yourself to the cards if you see additional shots when you are doing the production.

After the production edit the slides and resketch the visuals on script pages writing the narration in the right hand column.

If you follow these basic steps in organizing your presentation, I believe you will have positive feedback from the learner that fulfills your original objective.

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A Look at Ourselves—Problems and Issues within Industrial Education Graduate Programs

David Bjorkquist

During the fall of 1975 the Graduate Studies Committee of the ACIATE mailed a questionnaire to heads of master's degree programs in industrial education listed in the Industrial Teacher Education Directory. The general purposes of this survey were to describe master's degree programs and identify some of the problems and issues associated with these programs.

There were 187 master's degree programs in industrial education identified enrolling an average of 66 students each. Of these, 71 percent were enrolled as off-campus and part-time students. About 84 percent of the master's degree students were enrolled in teacher education programs. One hundred institutions provided a total of 477 assistantships with an average annual stipend of 3,256 dollars.

Undergraduate grade point averages of 2.5 and 3.0 (on a 4.0 scale) were required for admission in 36 percent and 27 percent of the programs respectively. An average of 32 semester hours was required for graduation. Of these credits, an average maximum of 14 semester credits was allowed in technical courses.

In attempting to identify problem areas in industrial education master's degree programs, respondents were asked to identify subjects with inadequate textbooks. Of all respondents, 64 percent listed one or more subject areas. Most frequently mentioned were history and philosophy (14 percent), instructional methods and individualized instruction (12 percent), curriculum development (12 percent), administration (10 percent), measurement and evaluation (10 percent) and research methodology (8 percent).

Other problems in the maintenance and promotion of master's degree programs were listed by 78 percent of all respondents. The most frequently stated problem was student recruitment (27 percent), followed by course and program updating (14 percent) and the quality and quantity of staff (14 percent). The general problem of resources or money was listed by 17 percent of the respondents.

The variations in admissions standards indicate that different clients are being served by the various master's degree programs. In addition, the differences in graduation requirements suggest that the outputs vary among master's degree programs. Hopefully, these variations in programs are the result of program objectives which differ and alternative plans for reaching similar objectives. To what extent have programs been planned to meet specified objectives and to what extent have they developed by following the course of least resistance?

Any practice in the operation of a master's degree program cannot in and of itself be identified as innovative. The innovation comes in the application of that practice to the accomplishment of a specified objective. There are several program characteristics which are being manipulated and could be used to try to have an impact on some of the most pressing problems identified.

There is no solid evidence to support this, but one gets the impression that master's degree programs in industrial education are auxiliary either to undergraduate or doctoral programs. At many institutions there does not seem to be enough time for the careful management of master's degree programs. Relatively few institutions seem to have faculty workload formulas which function to relieve faculty members of other responsibilities to work with graduate students. The result may well be that few programs receive the day-to-day attention needed to be distinctive and creative.

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Identifying the Concepts—The Pros and Cons

Ralph C. Bohn

The need for alternative forms of education begins with feelings of dissatisfaction toward the traditional programs of instruction. The concept of building instruction to meet the needs of people, the identification of new instructional modes and media and the desire to improve existing programs combined to promote the development of alternative forms of education. An alternative form of education is therefore one which represents an alternative to the traditional curriculum, the traditional time frame in which courses are taught, the traditional method of instruction and/or the traditional place where instruction is held.

An alternative education program normally incorporates one or more of the following characteristics:

- A curriculum designed for the practicing professional.
- Individualized self-paced instruction.
- Class meeting times planned in terms of student and curricular needs.
- Class location planned to be near students or at locations providing an appropriate instructional "atmosphere."
- Competency based with evaluation based on competency attainment.
- Professional internship as a culminating experience.
- Instructional methods based on course content and analysis of modes of learning most beneficial for students.

There have been many questions asked regarding the feasibility and desirability of using alternative forms of education. We will be addressing some of these questions here. A few which have been raised on numerous occasions are:

- Should graduate degrees be directed toward "scholarship and growth within the discipline" or toward improved performance within the profession?
- Should instruction occur on campus or at appropriate centers with library facilities or in the community close to the practitioner?
- Should the traditional modes of instruction and evaluation be superseded by unproven instructional methods and evaluation techniques?
- Can weekend seminars, all day classes and individualized instruction with few or new class meetings be substituted for the semester course?
- Do competencies handicap the "creative teacher" and discourage intellectual discourse in favor of gaining measurable skills?

It is quite obvious that many alternative forms of education are simply improvements within existing programs. A discussion of alternative forms of education should probably exclude these programs.

Proponents of alternative forms of education identify a number of advantages, including:

- Alternative programs represent an introduction of new ideas and technology into a teaching situation.
- Alternative programs provide an "alternative" and are not designed to be a substitute for existing programs.
- Alternative programs normally provide immediate results since these programs are usually directed toward improving skills of practitioners.

Critics often argue that:

- Alternative programs are often used as shields to protect poor curriculum planning and/or poor instruction.
- Alternative programs are often used by the "entrepreneur" to profit from education by:
  - —Marketing poor instruction.
  - —Selling credit (maximum units with minimal instruction).
  - —Selling degrees (a midpoint between legitimate degrees and "mail order" degrees).

When used as a means of providing a high quality alternative to existing programs, alternative programs become acceptable to most educators. However, when questionable motives and practices are involved, the profession should be the first to raise questions and discourage or eliminate the questionable practices.

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The External Doctorate in Education: Program Description and Acceptance by Educationists

James J. Buffer, Jr.

External study from proprietary institutions to obtain "credentials" is not a new phenomenon in the United States. However, it has not really plagued the field of education since employing agents — nam[illegible], school boards, superintendents, college and university administrative staff — have generally demanded degrees from accredited institutions. The increasing number of proprietary institutions "offering" graduate degrees in education and the unusual growth in enrollees and graduates have caused some concern regarding the credibility of the education doctorate.

The purposes of the study were: 1) To analyze common program requirements of the major external institutions in the United States and 2) to determine the acceptability of the programs by administrative personnel in industrial arts.

The Program

Several institutions (mostly nonaccredited proprietary institutions with minimal entrance and exit requirements) have recently created "external" Ed.D. and Ph.D. programs for experienced teachers and school administrators. In these programs, no formal residency is required; however, most require student attendance in one summer session of concentrated scholarly study of three to five weeks' duration. Some require additional course work to be taken at local accredited institutions or by correspondence from the external institution. Dissertation requirements typically are essays or field reports which may be an individual or group effort.

Degree Acceptability

Chairpersons and college deans of industrial arts provided information relative to the acceptability of the external doctorate as a criterion for initial employment, promotion within ranks, tenure and approval to advise graduate students. A majority of the respondents felt that the external degree was generally not acceptable. However, a few suggested that the earned doctorate was only one factor to be considered, especially as it

relates to tenure and promotion. A selected group of school superintendents, principals, and secondary teachers, along with external degree students, recipients and advisors were asked to list the strengths and weaknesses of external doctoral programs. Their responses were somewhat congruent (although not as negative) as the university chairpersons and deans and are summarized below:

Strengths:
1. Flexible admission policy.
2. No formal residence other than summer session.
3. One can maintain his/her present position.
4. Limited to professional practitioners.
5. Actual formal course requirements taught by experienced practitioners.
6. Independent research requirements supervised by someone in his/her immediate geographic area.
7. No need to disrupt one's family by relocation for a year or two of full-time graduate study.

Weaknesses:
1. Not appropriate for those who desire to become researchers — more appropriate for the practitioner in education.
2. Lack of continual interaction with a variety of graduate students and community of scholars.
3. Graduate assistantships provide beneficial learning experiences for doctoral students that cannot be replicated by continuing one's regular employment which merely promotes provincial thinking.
4. Less demand for scholarly performance, analytical thought and creative pursuits in a variety of substantive areas.
5. Degree is held as suspect by many persons in the community and in the profession.
6. Lack of formal assessment of the program or evidence to maintain the integrity of the terminal degree.

Summary

The reactions of two graduate school deans were consistent with the reactions of most of the respondents. They generally were not in favor of external doctoral programs. They suggested that the growth and acceptance of the programs were, in part, responding to salary and certification requirements of local school systems. Programs were perceived as convenient ways to obtain credentials and usually were associated with less academic rigor and scholarly demands. If anything, they perceive the external degree as a negative indictment of graduate study in education.

The credibility of the education doctorate offered by major accredited institutions will suffer, especially if the external degree with its emphasis on life experience is accepted as a viable alternative. Teacher educators must critically review the entrance and exit criteria for their graduate programs to determine how graduates of an external degree program differ from those of our conventional programs.

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Effective Management of Contract Activities

Donald L. Clark

What is your reaction upon hearing that one of your peers has been awarded a grant for a research, developm l or training activity? Whatever your reaction, you may be interested to learn just how he or she secured this support. It is often as simple as this: He or she had an idea and was able to sell it. A significant problem or activity had been

identified, properly described in a proposal and submitted to an appropriate funding agency.

Securing funds to support a project, however, does not necessarily guarantee its success any more than buying a previously successful business is a guarantee that the business will continue to be profitable. For any venture to be successful, it must be undergirded with an effective management system.

Industrial educators at both the secondary and postsecondary levels are often called upon to develop proposals for funding; then when funding is secured, to serve as project directors for the proposed activity. Many individuals have received professional preparation in how to prepare proposals; however, very few individuals have considered the important element of project management. It can be accurately stated that the success of a contract activity is directly proportional to the effectiveness of the management of the project. For purposes of this discussion, I would like for us to consider four basic questions regarding effective project management.

I. When should project management start?
II. Who is responsible for the effective management of a project?
III. What elements need to be considered in effective project management?
IV. When are the responsibilities of the project manager completed?

I. WHEN SHOULD PROJECT MANAGEMENT START?

Officially, project management starts as soon as notification of a grant award has been received. In reality, however, it starts with the conceptualization of the project and should be included as an integral part of the original proposal. In fact, the inclusion of a management plan is in most instances one of the elements that funding agencies carefully consider in making grant awards. Many proposal guidelines and RFP's (Request for Proposals) request such a plan and may place considerable weight on it in the evaluation section.

II. WHO IS RESPONSIBLE FOR THE EFFECTIVE MANAGEMENT OF THE PROJECT?

A related question could be asked: Who received the grant — the individual who wrote the proposal or the institution? In most cases, the grant is made to an institution; thus, the administrative structure of that institution will dictate how the grant will be administered. However, even if an institution employs a full-time grants administrator, the individual identified as project director in the grant award document is the person responsible for the effective management of the project. In most institutions of higher education there are established offices for contract activity, and it behooves the project director to effectively utilize the services provided by these offices. The wise project director will make it a team effort and benefit from the experience of the grants manager.

It is also appropriate to involve other project members in selected management activities; however, the ultimate responsibility for management decision-making belongs to the project director. When the principal investigator (if this is someone other than the project director) and the research assistants must utilize their time in management functions, then the project may be impaired.

III. WHAT ELEMENTS NEED TO BE CONSIDERED IN EFFECTIVE PROJECT MANAGEMENT?

The items presented in this section are not intended to be all inclusive, nor are they mutually exclusive. However, it is believed that each element presented merits consideration as an element in effective project management.

Grant award document. The grant award document, including in most cases a copy of the original proposal, forms the legal guidelines under which the grant or contract is to be conducted. In reviewing the grant award, it is important to review all attachments and references to regulations that have been published previously. If a revision is requested in the work schedule either at the time the grant is received or at a later date, it is important that it is reflected in the original grant award. It can be a serious mistake to agree to a reduction in an original budget without insisting that a corresponding modification in the scope of work be reflected in the grant award.

Staffing. The staffing plan needs to be well-documented in the original proposal, both in terms of positions to be filled and in the qualifications of the personnel to fill the positions. The project director is generally identified by name in the grant award document, and if a change at this level is made it may require the concurrence of the funding agency. The importance of employing staff members, including the secretary, who have qualifications to accomplish the task at hand cannot be over emphasized. Providing employment for individuals who just happen to be available generally does not provide the best yield. A major problem encountered by project directors in institutions of higher education is the employment of faculty members at 25 to 50 percent time on a project who are subsequently given teaching loads and committee meetings that seriously cut into the time allotted to the project.

A good management system will provide guidelines for line and staff responsibilities and further will allow each staff member to know where and how he or she fits into the organization. It can also provide the opportunity for each staff member to make a full contribution. Staff involvement will most likely assist in the operation of a successful project; however, the factor of greatest importance is the initial selection of staff members.

Facilities. The facilities needed to carry out effectively a project are generally furnished by the institution receiving the grant. Rent in most cases will not be charged to the project because it is covered by the indirect costs rate established between the grantee and the grantor. The commitment of an institution to the support of R & D activities can generally be determined by the quality of facilities provided.

A good plan of action is to identify in specific terms the type and quantity of space that would be needed to conduct the project in the original proposal at the time the institutional sign-off is required. The type and quantity of space provided by the institution might also be reflective of the management ability of the project director.

Work schedule. PERT or some modification thereof should be implemented. A graphic schedule — a map — needs to be developed and posted that allows each staff member to see how he or she fits into the organization and, more importantly how the tasks to be conducted by each staff member fit into the overall time frame. A detailed, graphic work schedule can be of great assistance to the project manager in making certain that some small but very important element of the project is not inadvertently dropped. There are many good texts on this topic that should be reviewed if the project director is not familiar with this technique.

Process evaluation. Program audit might be a better heading for this section. Audit procedures should be detailed in the original proposal and written into the budget. If funding permits, it is a good plan to have a third party evaluator make an objective review of the project. Project personnel sometimes get too close to a project to be objective in an assessment of its effectiveness.

Maintenance of records. The funding agency generally requires an accounting of funds. The fiscal office or grant office generally handles the accounting of funds; however, this does not remove the responsibility of good funds management from the project director. In order to do this he needs accurate fiscal records. A final report for the project detailing the process utilized and the ultimate yield of the project will not be a major task if good records are maintained from the inception of the project.

Monitoring of funding. Most projects do not operate on an even-flow budget. On a 100,000-dollar grant for a 10-month project it is seldom that 10,000 dollars would be spent each month. Most fiscal control offices cannot monitor much more than an even-flow. This, it is imperative that the project director review, at least on a monthly basis, the flow of funds and make adjustments when necessary.

Interim and final reports. As a minimum, reports must be submitted to the funding agency or its designee as indicated in the grant award document. A form and format for the required reports is often provided by the funding agency. In the absence of good records, the preparation of reports becomes an onerous if not impossible task. With good records it can be a rewarding experience as well as serving as a synthesis of the project.

IV. WHEN ARE THE RESPONSIBILITIES OF THE PROJECT DIRECTOR COMPLETED?

Technically, the project director's responsibilities end with the submission and acceptance of the final report. They may diminish; however, in reality, they will never end.

Based upon the yield of a funded project, the project director needs to pursue with professional diligence other related projects. If the project were a basic research activity, it should have a yield from which an applied project could be developed. If it were an applied research project, it should lead to an inservice training program. If it were an inservice program it should lead to a preservice program. Moreover, any of these programs can generate related R & D or training activities which will allow for good stewardship of funds as well as continued professional development for the project director and the profession which he represents.

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Educational Technology for Teachers of Humans Varying in Everything

Francis E. Clark

Many of us find it difficult to break from the teach as we have been taught syndrome. As a result, some teacher educators teach people how to write objectives without written objectives to guide the instruction; some teach people how to construct valid tests and then measure student progress with instruments that violate the very principles they champion; others teach people how to individualize instruction via the lecture; while still others teach peopl how to produce instructional resources such s nonprint media, without employing nonprint media.

We, as teacher educators, make the decisions which spell , owth or stagnation, performance or pretense. It is true that all teacher competencies cannot be identified through critical-incident methodology. Nonetheless, much of the content that we are teaching would probably be eliminated if it were based upon observations of ourselves.

Since most human beings learn best through practice and example (modeling), the only logical way out of this syndrome is to practice what we teach. Otherwise how can we justify a teacher education curriculum that includes as content competencies and procedures that we ourselves do not hold or apply? Likewise how can we justify our criticism of preservice teachers who conclude that teacher education is at worst a bore, at best irrelevant?

With this view of teacher education, the Educational Technology Program within the Department of Industrial Education at Texas A&M University is attempting to practice what is being taught. Three years ago, the objectives for the undergraduate survey course were analyzed. It is a laboratory course pertaining to the selection, preparation and utilization of instructional materials. The clientele are undergraduate students in teacher education programs.

The analysis, coupled with student feedback, indicated that the emphasis was on the media and doing things rather than on the message and achieving things. The main thrust of the content was more closely associated w the physical symbols of technology, new devices or physical inventions, than with the systematic application of knowledge to practical problems of a particular field of study. From a modality point of view, the course was group-oriented and norm-referenced. This overall philosophy did not parallel that of other courses within the teacher education curriculum.

In an effort to focus attention on the application of both the intellectual and physical aspects of technology and without losing sight of the individual learner, the course was systematically redesigned around the following factors: (1) Entry level behaviors of preservice teachers, (2) performance-based objectives, (3) activities designed to evoke the behaviors delineated in the objectives, (4) performance check sheets and written evaluation instruments, (5) existing materials and equipment, (6) the physical nature of the classrooms, (7) available instructional and support personnel and (8) constructive criticism from both preservice and inservice teachers.

The content was derived, in part, from a list of instructional competencies identified by inservice teachers. Also, the existing instructional hardware and software in the

public schools were factors in the final selection of content since it would be unproductive to learn to utilize materials and equipment which are not readily available.

With the instructional competencies as guides, the emphasis was on learning rather than on teaching. The curriculum was separated into 10 self-contained, performance-based, individualized learning packages called "modules." A module, such as "explain a concept using the overhead projector," required the preservice teacher to: (1) Write behavioral objectives in the cognitive, affective and/or psychomotor domain(s), (2) plan learner activities which incorporate transparencies as one of the instructional mediums, (3) design a short evaluation instrument for the lesson, (4) learn how to operate the hardware in route to designing and producing the software and (5) present the lesson to a group of peers. Presentations were videotaped and critiqued by the instructor and the student.

It was soon realized that the rationale for the selection of resources was backwards. One should start with an instructional objective and choose the best suited medium for communicating the message rather than start with a medium, delineated in the form of an instructional competency, and attempt to format the message around the peculiarities of that medium. Also the modules only individualized instruction in terms of student completion time and caused undue stress on procrastinators. From a strategy point of view, there was still no chance for the students to fulfill their individual instructional needs. Strategy-wise, there is no difference between all students listening to a lecture and all students working modules; both are methods of delivery. We had been led to believe, as so many others before us, that by organizing content in the form of modules, we were allowing for individual differences.

In spite of the course limitations, student feedback was excellent. They liked the activities, and they liked knowing whether or not they were successful. They enjoyed the informal atmosphere within the laboratory because it was conducive to the exchange of ideas. However, the modules, coupled with the lack of selection criteria, caused us to reassess the system and the content. As a result of this analysis, it became evident that if learning is the ultimate product of the instructional environment, then the instructional environment is the product of the interaction between and among the teacher, the learner, the task and the resources (materials, equipment and methodologies).

For the first time it was realized that the instructional variables dealt with in designing the course were the same instructional variables that the preservice teachers would be dealing with upon employment. Therefore it was decided that a portion of the content for the course should be derived from the same decision structure utilized in designing the course. In other words, we now have a course that requires preservice teachers to make the same decisions about the instructional environment that were made in designing the instructional environment they are experiencing; the course is an example of a working system.

As work continued, our ideas evolved into a framework composed of five learning spaces. A learning space was defined as "A meaningful unit of performance-oriented (and/or product-oriented) learning experiences, structured around essential components."

The overriding purpose of our instructional system is to differentiate and coordinate time, personnel and available resources to maximize the learning opportunities for all students. The five content units within the system include the ORIENTATION SPACE 0, OPERATION SPACE 1, ANALYSIS AND SELECTION SPACE 2, MESSAGE PRODUCTION SPACE 3 and INSTRUCTION SPACE 4. Hazarding oversimplification, let us take a look at the purpose, student activities and evaluation procedures for each learning space.

ORIENTATION SPACE 0 is designed to provide preservice teachers with a frame of reference for the course relative to their future needs as teachers. It answers the question, "How can this course help me do my job as a teacher?" The intent is largely informational, establishing goals, objectives, activities and evaluation procedures for each learning space. Classroom operational policies and routines are explained in accordance with how the learners are expected to respond to what instruction. The interrelated nature of the learning spaces is depicted, and recycling procedures are discussed. Other constant elements, such as textbooks, activity guides and course requirements, are described in relation to variable elements such as learner needs and expectations.

OPERATION SPACE 1 provides each student with hands-on experiences in an informal environment. By successfully operating the hardware to produce software, apprehensions about using equipment are reduced. Preservice teachers gain experience in setting up and operating projectors, recorders, cameras, duplicating machines, laminating presses

and television equipment. They learn to discriminate between equipment that is operating properly and that which is not. They learn how to change projection lamps and practice trouble-shooting procedures and simple remedies for common difficulties. They become aware of the difference between production and presentation equipment. Where appropriate, they produce software and compare it to quality examples. They relate the instructional advantages of media to restraints such as cost, preparation time and student appeal.

Performance and product-oriented activities are evaluated by comparing them to model and quality criteria. Each student has the option of recycling if the teacher-student assessment indicates unacceptable competence. Once the student has completed all required activities, he is armed with the fundamental skills necessary to operate both production and presentation equipment.

ANALYSIS AND SELECTION SPACE 2 concentrates on the process of collecting information necessary to reach decisions about what to teach, how to teach and how much to teach in relation to restraints such as costs, time, space, equipment, teacher competencies and group size. In essence, the analysis should lead directly to an instructional design that specifies preplanned interactions between and among the teacher, the learner, the task and the resource (materials, equipment and methodologies), resulting in an instructional environment where responses are predictable.

The preservice teachers gain experience in identifying learner capabilities as opposed to deficiencies. If instruction is the transmission of information from one person to another and we communicate with learners through the senses of hearing, seeing, touching, smelling and tasting, then these learner capabilities become important considerations in the design of the message. Whether the learners think in terms of relationships or differences will also influence the design of the message and the method of instruction. Prerequisite internal learning conditions may also modify the way in which the learner responds to instruction.

When considering resource attributes such as intent, format and restraints, answers to the following questions serve as guides in designing and selecting mediums. Is the intent to reinforce, reinstate, provide repetition or verify? Is the intent of the stimulus sensory (subjective) or vicarious (objective) in nature? Is the format sequential or non-sequential, intermittent or continuous pace, resolved or open-ended? Are there cost, time, equipment or space restraints?

To establish the conditions for instruction, the preservice teachers first identify the task in the form of an objective. They classify the objective according to the conditions of learning advanced by Gagné (1970) and describe the external conditions that will be controlled during instruction.

At this point in design, decisions about the instructional conditions are made. Identified characteristics of the learner, task and resources are considered along three major dimensions. The objective of this configuration is to correlate the intent, format and restraints of a medium (whatever it may be) to the external conditions of the task and the internal and external attributes of the learner. This decision structure disciplines thinking and allows the preservice teachers to make systematic comparisons they may otherwise fail to perceive.

MESSAGE PRODUCTION SPACE 3 focuses on the functional, rather than the imaginative, uses of the five senses in relation to available resources. For instructional purposes, the accuracy and quality of the message is crucial. The goal is to design optimal messages in terms of understanding and response on the part of the learner. In short, if we want to communicate with others, we must meet their needs rather than our own.

Message production is built on a careful analysis of the external conditions of the learning task in relation to learner capabilities. The preservice teachers are required to storyboard and/or script each message. They employ both structural and functional techniques in designing visual and auditory messages; they also discriminate between digital and iconic signs.

They answer the question, "What is the message?" before actual production begins. In answering this question, they must discriminate between message intent and message content. Finally, the probability of success is discussed in relation to the identified task conditions and learner attributes.

The preservice teachers then begin the last phase of production, the manipulation of hardware. Prerequisite competencies related to production equipment accomplished in OPERATION SPACE 1 are employed in the actual production of the media.

INSTRUCTION SPACE 4 encompasses both realistic and simulated instructional situations. The preservice teachers now complete the instructional planning, preparation, presentation cycle by microteaching the specific tasks designed during other phases of the course.

Microteaching is providing instruction for 5 to 10 minutes, instead of the regular 30 to 50 minute class period; 3 to 4 students, instead of the normal 25 to 35 students; and dealing with one main idea rather than the many issues brought out in a class session. In preparation for microteaching, preservice teachers practice integrating the media and themselves into a smoothly functioning whole. Weaknesses can be identified and corrected through peer feedback and self-appraisal.

Since instruction is a very complex process with many carefully and intricately interwoven skills, the use of a television camera and monitor is one of the more advantageous aspects of microteaching. By recording the instructional sessions on video tape, the teachers are able to view, analyze and to an extent evaluate their own effectiveness.

The elimination of unnecessary intuitive and extemporaneous instructional activities is the goal to be achieved by preplanning the unique contributions of both human and non-human resources. Beyond master of subject matter, the teacher is characterized as a facilitator of learning and a decisionmaker, rather than a taskmaster.

Meanwhile, the question remains, "Will this instructional system work?" The answer depends on the instructional environment and, to a large degree, the preservice teachers. The success of any course depends upon the good, or perceived good, to be attained from the experience. Therefore, the only tenable answer to this question is "maybe."

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Technology Education Teacher Center

Paul W. DeVore and David L. McCrory

Numerous individuals in the field of education have recognized a critical variable which militates against the improvement of education and educational systems. The variable is inservice teacher education in its many and diverse forms.

The conclusion of most researchers has been that inservice education, as traditionally conducted, is an outright failure. It seems that Goodlad (p. 61) is correct when he states that "education is probably the only large scale enterprise that does not provide for systematic updating of the skills and abilities of its employees."

Millions of dollars are spent each year by teachers and school systems on inservice courses and degree programs. Yet, the overall results are not generally observable or measurable with respect to the improvement of the education of children and youth. The primary result, if not the primary goal, is additional certification and salary increases, not measurable improvements in the education of children.

In addition to the extensive amount of money and time devoted to the inservice process, considerable time and effort have been devoted to research about teaching and learning. Only a brief analysis of the present state of the efforts in inservice education and research is required to determine that if breakthroughs in research about teaching and learning are to be transferred to practice, then a new and more effective system must be devised for the inservice education and training of teachers.

One approach to meeting the need for a more effective system of inservice education has been the design and development of a new delivery system, one committed to improving teaching and learning. The new delivery system is called a "teacher center."

There are many types and styles of teacher centers, some with specific missions, such as the Technology Education Teacher Center at West Virginia University which is the subject of this report.

The Technology Education Teacher Center was designed as a pilot model for a specific field of study, technology education. The description of a teacher center, delimited

to one field of study, should be a relatively easy task. This, however, is not the case and for one specific reason. The teacher center is an entirely new concept. Educators with experiences in traditional inservice education efforts find the teacher center concept foreign to their thinking. They discover that to function effectively within a teacher center environment, they must develop entirely new ways of thinking and behaving with respect to inservice programs.

Those who have been involved in the design and implementation of the teacher center concept have discovered it is necessary to pursue the design and implementation from a perspective different from typical educational efforts. These efforts, for the most part, utilize workshops and graduate coursework for inservice education with the primary emphasis and focus on credentialling, not the improvement of instruction. The new inservice model is a change model. The criteria for success is actual, observable, measurable change in teaching and learning in real on-going classrooms. As a result, the subtleies of operation of a teacher center are highly complex and interrelated. The end results, however, for those interested in working with schools and teachers to improve the education of children are significant and well beyond the expectations of experienced educators.

There are several significant topics which need to be discussed if the fundamental concepts of the design, development and operation of a technology education teacher center are to be understood. These include historical background of the center, the design of the center (philosophy, assumptions, purpose and function), program plan, organizational plan, operational plan and selected observations about the center with recommendations for future efforts.

THE TECHNOLOGY EDUCATION TEACHER CENTER HISTORICAL DEVELOPMENT

The Technology Education Teacher Center at West Virginia University was initiated through efforts by a Task Force of the NDEA National Institute for Advanced Study in Teaching Disadvantaged Youth. The work of the Task Force culminated in a publication entitled, Teachers for the Real World, by B. Othanel Smith, Saul B. Cohen and Arthur Pearl, all members of the Task Force.

In the publication, the authors recommended the establishment of what they termed Training Complexes, the forerunner of teacher centers. The rationale supporting the recommendation was impressive. The focus was on training. The authors reminded educators that "student teaching was rated high by prospective teachers because it was the only work they have which resembles a training experience." Yet the authors found, when they examined teacher preparation programs, that "there has never been a program of teacher training, only a program of courses ending with student teaching." Their recommendation for the improvement of classroom teaching was to retain the critical research and theory elements of teacher education and add a new component to the system which would focus on training. The training component of the new model would be called a "training complex."

It was from the publication entitled Teachers for the Real World and the ideas associated with the question of inservice training and performance that the Technology Education Teacher Center at West Virginia University developed. There were, of course, a number of intervening steps.

Teachers for the Real World provided the impetus for the United States Office of Education to establish several national advisory committees, one of which was the Advisory Committee on Training Complexes. The Advisory Committee on Training Complexes convened first on February 27 and 28, 1970 and concluded its initial work on July 1, 1970. During this time period, the committee formulated a design for training complexes including operational assumptions, a descriptive definition and guidelines for the establishment of training complexes. In addition, a number of proposed models for training complexes were reviewed and evaluated. Included were the Japanese model, the English model and training models developed and operated by business and industry.

Following these studies, the advisory committee recommended that five micro-pilot models be funded and tested, beginning in July 1970.

One pilot program recommended for funding was known as the Northern Appalachian Training Center for Teachers in the Technologies at West Virginia University. Initial development of the pilot program began in July 1970. For field use the pilot program was called the Training Program for Teachers in the Technologies (TPTT).

The micro-pilot program at West Virginia University was operated from July 1970 through June 1971, and was successful beyond original expectations. The present effort, called the Technology Education Teacher Center, is based on experiences of the pilot program. Each year the program has been altered and expanded according to the results of experience and the original design criteria.

To date, there have been five developmental stages in the evolution of the Technology Education Teacher Center. Each stage of development coincides with yearly plans and projections for training programs for teachers in the technologies in West Virginia and the Appalachia Region.

1970-71. First Year. Pilot program. Implementation and assessment of technology training model developed for the project. Five county supervisors and ten teachers involved. Goal: Teach new technical content, design new units of instruction and teach students in participating teacher's own classroom or laboratory. Cooperative program established with State Department of Education and program specialist for industrial arts. Curriculum Research and Resource Center established.

1971-72. Second Year. Continuation of first year effort. Sixteen new teachers involved. Program expanded to include efforts to train teachers (training associates) as field trainers. Two stages. Stage one included new content, new strategies of teaching in the technologies, the design of units of instruction and the testing of the units in home classrooms. Stage two involved the development of beginning competencies necessary to serve as field trainers and adjunct staff members of the Training Program for Teachers in the Technologies. Precision teaching-learning unit development program initiated with eight teachers. Regional training meetings and administrator information programs designed and implemented. Expansion of Curriculum Research and Resource Center. Program specialist for industrial arts appointed as adjunct faculty member and co-director of Teacher Center Program.

1972-73. Third Year. Continuation of programs originated in first and second year with emphasis on Regional Training Meetings and Administrators' Information Meetings. Precision Teaching Learning Unit program continued. Expansion of Curriculum Research and Resource Center. Field Associate Training Program development continued. Design and operation of inservice program by teachers trained as field associates. Project Open Model conceived and developed. Two models initiated: The Consultant Model and the Teaching Model. Two Project Open contracts for curriculum development initiated. Training Program for Teachers in the Technologies Newsletter initiated.

1973-74. Fourth Year. Continuation of programs originated in first, second and third years. Full time coordinator of Teacher Center (Field Service Programs) employed. Additional facilities for Teacher Center obtained. Project Open Models implemented in two county school systems. NASA program in aerospace education initiated. Inservice workshops for teachers and administrators continued with emphasis on curriculum and instructional design. Q.R.C. (Quick Reaction Capability) program initiated with workshops on metrication and unified arts.

1974-75. Fifth Year. Continuation of programs originated in previous four years. Regional teacher and administrator workshops expanded. Q.R.C. program expanded to include programs on energy. Project Open Model expanded. Unified Arts program developed. NASA program continued and Aerospace Workshop program initiated. Precision teaching-learning unit development program continued. Expansion of Project Open Model to three counties, five schools.

The history of the Technology Education Teacher Center has been one of constant growth and expansion of role. Much of the success of the center can be traced to the original design committed to inservice education.

DESIGN OF THE TECHNOLOGY EDUCATION TEACHER CENTER

The prime focus of the Technology Education Teacher Center as originally conceived was training, the training of inservice teachers. The focus on training required a new perspective, a new mentality on the part of those responsible for the operation of the center. Typical institutional organizations and viewpoints related to inservice education

of teachers were found to be inadequate. The Technology Education Teacher Center, with a heritage derived from the training complex concept proposed by B. O. Smith in Teachers for the Real World has a clearly defined training mission directed toward the development of complex, integrated skills appropriate for teaching in a variety of institutional settings. The present teacher center was developed with a focus on characteristics which differentiate a training complex or teacher center from other institutional programs. For instance, a training complex includes:

1. Provision for the active participation of those concerned with decision-making regarding the training of educational personnel.
2. Utilization of a wide range of resources: The schools, colleges, universities and community to develop and staff training programs.
3. Opportunity for inservice (and preservice) teacher training to be conducted in school settings, thus drawing on the strengths of the school by providing for real problems encountered in classrooms and in school organizations during the change process.
4. Flexibility in employing personnel from varied backgrounds, with or without the standard credentials necessary in other settings.
5. Utilization of the center staff in patterns not considered possible or appropriate in traditional university or school based inservice training programs.

Teacher centers are designed to meet a wide range of training needs. The operational mode is problem centered with the goal of solving problems, not of perpetuating antequated systems. The function of a teacher center is to train, to capitalize upon its unique environment and relationship to the educational process and thereby provide direction to the kind of training required by educational personnel inservice. To do so the teacher center provides, for personnel who have not been prepared to conduct successful instructional programs, access to identifiable and specific training contexts.

The teacher center operation, therefore, must be flexible in the development of training services. The services must be specific to the personnel, the region and to the educational environments in which they are provided.

Another characteristic which separates a teacher center and its activities from typical inservice efforts and curriculum development projects is that centers are interinstitutional and complex. They provide multiple outputs and require multiple, diverse and specifically designed inputs. Centers are thus useful for installing systems which are innovative and are expected to endure. Programs in which teacher centers are involved are best thought of as long range change models.

The Syracuse University Teacher Center Study Project defines a teacher center as:

> A place or places where a program exists that offers educational personnel (inservice teachers, preservice teachers, administrators, paraprofessionals, etc.) the opportunity to share, to have access to a wide range of resources, and to receive specific training.

The Technology Education Teacher Center at West Virginia University is compatible with this definition but differs significantly from typical teacher centers in many aspects, one of which is the focus on change. The Technology Education Teacher Center is focused on change, and the program design is based on research on change. There are several reasons for this.

Many educators have stressed the need for change. They call for new curricula, new programs, new instructional media and pilot programs, all for the purpose of improving the educational process. Calling for change is one thing. Actually attaining substantive, meaningful and long term change is another problem and a major problem.

Change and improvement in the teaching-learning process take place only when people are ready for change, when people are prepared and when they have the competencies to initiate and carry out change. These criteria identify important functions which must be considered in the design of the teacher center. The purpose of the teacher center, therefore, becomes one of increasing the competency levels of teachers so that they are more secure with change, more capable of engaging the questions of the quality of instruction and more knowledgeable about the structure of schools in relation to learning inhibition and good teaching.

The emphasis of the technology education teacher center at West Virginia University has been on the individual teacher and his development as a self-sustaining teacher-

scholar capable of engaging the questions and meeting the challenge of change. This process requires continual training as well as the movement of the concern for training and improvement in competence from the colleges, universities, and other public agencies to the individual. To attain this goal requires knowledge and implementation of the theories and practices of the change process. There is a vast body of literature on the change process which has implications for change. Some of the more important factors derived from the study of the change process are included in the following section on the change process.

The Change Process

Change is always occurring. The question is, what type and in what direction? Planned change is possible and is generally considered a desirable goal. We know we can attain change. We also know there is a large gap between theory and practice. In the field of education knowledge of both the theory and the practice of change is weak.

We know that present day inservice teacher education programs produce little change which affects the quality of instruction. We know that one of the reasons for this is that programs are not evaluated. And we know that programs without precisely-stated objectives are next to impossible to evaluate. In fact, evaluations of programs without performance objectives or criteria are largely subjective exercises in futility.

We know much more about change and the change process than most educators are willing to admit. It almost appears that educators are reluctant to use the tools available to them for engaging in planned change.

We know that the variables affecting change involve diverse elements such as philosophy, people, programs, performance, places, practices, projections and planning, to name a few. We know that the process of change is complex. We know that it requires knowledge and skill of a high order to direct planned change.

We know that many of the variables concerning change relate to the diversity of goals in education and the lack of a structure within the educational establishment to plan and manage change, including the preparation and training of such specialists as those required for quality control — the evaluators.

We know it will be necessary to create special organizations to service the change process including the critical variables of evaluation and training. School systems at present are not equipped to handle these functions without outside assistance.

There are many suggestions and recommendations that could be made with respect to changing inservice teacher education. In fact, there are lists ranging from 4 or 5 items to 20 or more. Some variables are more critical than others.

For instance, if a decision is made by a given political entity with direction and control over education to change inservice teacher education, then action devoted to the following variables has been found to be in order.

1. Formulation of precise, long-term developmental plans.
2. Development of specialists including managers, change agents and evaluation specialists.
3. Establishment of programs for the study of the change process, including research and evaluation.
4. Commitment of funding sources to long-term ventures so the critical variables of resources and follow-up can come into play.
5. Structuring all phases of the program so there is direct involvement of teachers in the process.
6. Designing all efforts so the focus of attention is directed from the part to the whole.
7. Creation of an "outside force" such as Training Centers with the long-term task of engaging the problem of improvement in the quality of instruction with particular attention to the first two years of a teacher's tenure.

Finally, a solution to the reward structure in education is a critical variable for personnel at all levels. This is important because in the last analysis it is people who change programs. The question is, "Why should they?" (DeVore, p. 61)

These and other findings of research on change and change models focus attention on the creation of a new delivery system for teacher education, the teacher center. Teacher centers vary considerably in their missions and in the designs and models utilized to carry out their missions. The Technology Education Teacher Center at West Virginia University is based on what has been described as the technology model.

The Technology Model

Fundamental to the design of the Center was the selection of a model from which structural and programmatic decisions could be made. The present design was based on a technology model with the assumption that self-realization, self-assurance and improved performance could be attained by teachers as their level of competency was raised. Competence and the "ability to do" enhance self-realization and self-assurance, critical elements in a successful teaching-learning equation.

The model as conceived was action oriented, as is technology, and met the center concept of providing brief, intensive opportunities for training in specific and identifiable categories.

Of the two training phases, preservice and inservice, the center was primarily concerned with the inservice phase. Concentration on inservice problems was based upon the tenet that the way problems are solved and situations changed is by "starting from where you are."

A teacher center utilizing the technology model concentrates on solving problems related to improving instruction in as economical and efficient manner as possible. The issue was one of putting to work knowledge and techniques already available. Some of the basic premises were:

1. That the tasks to be identified would be those which teachers and others expressed as needs or which, as a result of involvement in training programs, teachers found relevant.
2. That tasks would be those which could be specified in performance terms and could be attained in short periods of time.
3. That the teacher center existed to provide services to local or regional educational personnel on contractual and other bases.
4. That the success of the center would be measured in terms of continued use on the part of its clients.

Program Design

Analysis of individuals who have performed consistently at high levels indicated a lengthy training process built in small incremental segments. Each increment or segment added to the repertoire of the individual and increased his competence level. A high level of performance is reached in a step-by-step procedure and attained when the total, consisting of all the parts, is put together into a meaningful whole. Unfortunately for many teachers some of the parts are missing, and a vision of the whole is never attained.

Many solutions have been proposed to correct these voids. However, most methods and procedures are so complex that highly trained experts are required for their application, thus making the solution low in efficiency and high in cost. In addition, the goal of disseminating training procedures to the local school level is obviated. The technology model is based on the assumption that the function of the teacher center is to find the means to teach all who are capable how to use and apply new techniques. Teachers have no faith in techniques which can be applied only by experts. This means the structure and program of the Technology Education Teacher Center must be geared to actual operational problems faced by the teachers in the field.

The concept of "starting from where the teachers are" is basic if real change is to take place. It is very difficult, if not impossible, to introduce radically new ideas without a lengthy period of preparation. Programs geared to actual operations have a greater chance of success. They also provide a much better base for continual change than do either short or long-term inservice programs begun on highly sophisticated levels or based on foreign, radical or esoteric ideas.

The real issues, then, are ones of structure and program. The technology model (starting from where the individual is and operating on the principle that competence is attained in short, specific, incremental stages) centers on tasks which are action or doing oriented. Problems are analyzed and divided into small segments suitable for short, highly defined training sessions. Immediacy and application to practice are the keys. The model is constant and on-going, utilizing all resources and expertise on an ad hoc basis as required by program goals and individual needs. The task analysis approach is used. Specificity is emphasized and the following assumptions utilized:

> When performance expectations can be defined in precise behavioral terms, systems can be developed to prepare teachers to perform them.

When variables enter into performance expectations, a series of diagnostic questions can be designed to aid in the definition of the problem. The model suggests that trainers can be prepared to ask diagnostic questions and to apply appropriate solutions or select appropriate learning systems for teachers.

When a reward or payoff is within sight, behavioral and attitudinal changes are not only probable but reasonably certain.

When teachers see specific connections between training programs, resultant proficiency on the job and the level of status, responsibility or income for which the training is to prepare them, attitudes toward training will be more positive.

Involvement with the technology model has indicated several other characteristics which should be noted. The focus is on the individual. Each individual becomes involved directly in the identification and development of his own program of improvement. The attempt is to develop awareness of potential and the skills and competencies required to attain a given competency level. The technology model concentrates on "what is to be." It is action-oriented. It is designed to improve the teaching-learning environment, including the modes of thinking, doing, acting and performing related to that environment.

The present program was designed and developed first as a pilot program utilizing limited resources. The goal was to develop a delivery system which could meet the criteria of less costs, more options. It was designed to determine answers with respect to the critical questions of (1) program and (2) structure prior to committing extensive resources to limited experience, know-how and professional competency.

The problem was to design and develop a structure and program for a technology education teacher center which could reach critical mass, one that could provide sustained leadership and training for teachers in the technologies in the State of West Virginia and the Appalachia Region. There was, of course, a present on-going day-by-day educational program in operation in West Virginia, a program with considerable tradition and much momentum. The objective was not to build a totally new structure or program. The objective was to work with what was, to start from where we were. The questions then became "What is?" and "How can critical mass be attained which will alter or change inadequate and in many instances nonexistent teaching-learning processes in the technologies?"

One conclusion reached during the early design stages of the program was that the answers would rest with the inservice teaching population. It was assumed that if real change was to be made in the teaching-learning process, then the classroom teacher, the individual responsible for program operation at the local level, must receive help. The functions of the Technology Education Teacher Center became evident as soon as this assumption was stated.

The present center was designed to serve the function of providing the state and region with a means for developing personnel qualified and capable of meeting the educational problems of a changing technological society. This required that procedures be designed to increase the knowledge and competency of educational personnel in:

1. Facts, concepts, principles and processes of the discipline of technology.
2. Instructional strategies compatible with the discipline of technology.
3. Diagnostic skills consistent with the problems and issues of technology education.
4. Curriculum design for the study of technology.
5. Instructional design including precision teaching-learning units.
6. Instructional resources for the study of technology.

Other characteristics of the technology model, critical to the implementation and success of inservice education programs for teachers in the technologies, are derived from the processes of technology. In this context process means modes of thinking, doing and performing. The technology model is primarily task-oriented and problem-centered. It is, therefore, process-oriented, focused on the future, adaptable and flexible. The emphasis is on problem solving and the methods of attacking problems using knowledge, analysis, synthesis, application to practice, evaluation and redesign, rather than problem doing which places emphasis on studying a body of knowledge for its own sake or dealing with problems already solved. Operated at its maximum potential, the technology model provides programs with a basis for projection and analogy, as well as a basis for assessment which utilizes two criteria, namely, economy and efficiency.

The technology model can be described best perhaps as a task analysis, performance based model. Implied is a hierarchy of goals and attainments which require different structural, programmatic and operational modes. The Technology Education Teacher Center at West Virginia University was designed not only as an on-going operational program but also as an on-going research effort to determine which structures, programs or operational modes are most valid for the improvement of education in the technologies at all levels.

Purpose and Function

The Technology Education Teacher Center has been concerned primarily with people and their needs and competencies as teachers. The purpose, function and scope of the programs of the center have changed and adapted as the needs, problems and competencies of the clients have been altered by the program as well as by their continuing professional involvement in day-to-day teaching activities. Purposes and functions are thus altered by changes in the educational environment in which the center operates. The criteria for success of the center and the criteria for continued operation have been whether the program of the center demonstrated to its constituency that its services met identifiable and agreed upon needs. The business of the center was not to stay in business. Its business has been to help provide answers and meet the needs of teachers in the technologies in establishing contemporary and quality programs of instruction. The ultimate goal has been to meet the educational needs of the youth in West Virginia and Appalachia in the study of technology.

These purposes and functions required that the question of the types of training personnel and their qualifications be identified. In addition, operational procedures had to be developed to train personnel for program efforts at the local, county and district levels. The latter goal required that center personnel engage in efforts which had the greater certainty of multiplying the initial effort. Critical to success in multiplying the initial efforts of teacher center personnel was direct involvement of inservice teachers in the change process, not only as learners but also as teachers of other teachers.

Another function, in addition to the role of personnel development, identified the role of the center as an "outside force." The center has had as its mission not only the improvement of instruction through the retraining of individuals but also a role as a third or neutral party in the design and development of new educational programs. The center functions not as a part of the local, county or district organization but as a consultant with influence on positive change through legal agreement as well as professional expertise. Thus, the nature of relationships and responsibilities are different from those of typical inservice operations. Those working for the center can initiate ideas, programs and procedures which those inside the system cannot or would not. The professional and interpersonal relationships are different. The center then becomes a new variable, a positive variable in the change process. The center as an outside force serves as a catalyst for change.

The center attempts to function, as much as possible, in a neutral role. This means the center delimits its formal attachment to specific university or state education department structures, other than to draw upon available resources. In a sense the center exists as an autonomous entity. Therefore, those observing the operation of the center recognize that the design, structure and programs, together with the neutrality factor, are essential if the center is to fulfill its role.

In addition, it is important to remember that the center was designed to draw together and organize resources required to solve problems rather than to expend energies in identifying problems capable of being solved by existing resources and programs. The mode of operation thus becomes ad hoc and open rather than static and closed.

PROGRAM OBJECTIVES

The program plan for the Technology Education Teacher Center requires the development of specific objectives for specific and identified functional categories related to the center's operation. The objectives provide direction for the center's operation as well as a substantive base for assessment of the work of the center. An indication of some of the objectives, by category, follow. By design, all objectives are stated in behavioral and performance terms.

Primary Objectives

A. Organizational-Operational:

1. Provide direct, tangible and specific leadership for the people of the state and region in meeting the needs of education in the technologies at all levels through the most economical and efficient means by serving as a research, resource and personnel training center.
2. Study, develop, evaluate and initiate activities which have the greater certainty of multiplying initial efforts in increasing the quality, scope and effectiveness of teacher education programs in the technologies in the state and the Appalachian Region.
3. Provide the state and region with an enterprise dedicated to aiding and assisting teachers in the technologies who are engaged in efforts to meet the needs of youth and adults through education in the technologies.
4. Provide the state and region with an enterprise which serves as an "outside force" designed to create favorable climates conducive to motivation, sustained systematic planning and other efforts required to aid people in rising above nonadaptive educational patterns in the technologies.
5. Develop and initiate effective and highly selective communication systems for the state to meet the problems and needs of education in the technologies. Systems should contain a "sensing" mode to determine weaknesses in the educational effort and a "scanning" mode designed to locate information and resources pertinent to the solution of identified problems.
6. Design, develop and operate an exemplary technological education research and resource facility adaptable to educational and technological change and capable of meeting the needs of the center's programs.
7. Study, develop, initiate and evaluate change strategies suitable for improving education in the technologies in the Appalachian Region.

B. Instructional-Educational:

1. Design, develop and implement procedures for monitoring the educational process in the technologies at all levels of education, both formal and informal, for the purpose of identifying present and projected human resource needs.
2. Design, develop, initiate and evaluate short-term training and retraining programs in the technologies for teachers in the field at all levels of education, both formal and informal, for the purpose of providing the state and region with personnel qualified and capable of meeting the educational problems of a changing technological society through procedures designed to increase the competency of these personnel in knowledge and performance in the areas of curriculum design, materials of instruction, technical content, instructional strategies and leadership.
3. Identify and develop a taxonomy of teaching skills from which to determine selected instructional program offerings for implementation by the center for teachers in the technologies.
4. Develop a matrix of potential instructional offerings from which a competency hierarchy can be determined and programmed and contractual arrangements determined.

C. Field and Community Service:

1. Design, develop and initiate an inservice educational model which meets the following criteria:
   a. Motivates individuals toward continuous learning and maintains, improves and adds to the competencies of those teaching in the technologies at various levels of education.
   b. Is flexible and adaptable to educational and technological change.
   c. Is capable of serving the needs of individuals or groups within the local community, at regional centers or at the Technology Education Teacher Center depending on need, complexity of instruction and resources required.
2. Develop a Regional Organizational Model whereby the center serves as a resource for the initiation and operation of programs for the solution of localized and immediate educational problems in the technologies as a means of increasing the cost effectiveness of efforts within the region through correlated and cooperative efforts.
3. Provide technical and educational field assistance for all levels of technological education in the state and region.
4. Establish, in selected urban and rural areas of the state and region, experimental and exemplary pilot programs designed to provide leadership in meeting the needs of education of children and youth in a technological society.
5. Initiate the utilization of pilot program facilities, on a contractual basis, for inservice technology education programs within the region.
6. Coordinate and provide liaison activities with other organizations and enterprises in the state and region concerned with technology and human resource development.

D. Education and Technology Resources:

1. Design, develop and evaluate program models, instructional models, materials of instruction, resource materials, teaching-learning units, physical facility designs and other software materials required for experimental, pilot and operating programs in the technologies as part of the technical, field service and out-reach functions of the center in meeting the needs of the state and the region.
2. Develop, organize and publish a master Technology Education Resource File identifying human, physical and published resources, both hardware and software, which are available to meet selected instructional and training needs.
3. Identify, evaluate, select and publish a descriptive listing of basic readings and resources for study in the technologies at several learning levels.

Secondary Objectives

In addition to the primary objectives, concerned with rather specific areas of endeavor, the center's activities are also determined by second order objectives.

1. Determine the specific nature of the many tasks related to the proper functioning of a Technology Education Teacher Center and establish a training hierarchy, in terms of personnel and the competencies required.
2. Study, develop and select reward structures which enhance the productivity of training programs for teachers in the technologies by promoting interest in self improvement.
3. Evaluate the many types of performance categories required for the proper functioning of training programs for teachers in the technologies and determine the potential utilization of scientific and engineering manpower in meeting these needs.
4. Conduct a study of the type and nature of services desired and required by teachers and instructional programs. Utilize nondirective data gathering devices to determine contemporary needs as well as exploratory discussions of the future to determine potential needs.
5. Investigate, evaluate, select and prepare guidelines for the operation of several modes of contractual programs.
6. Explore, assess and determine the potential of establishing a multiple funding consortium for the diverse activities and needs of a technology education teacher center.
7. Design, develop, initiate and operate pilot training centers in the technologies in selected schools in the region for the purpose of establishing change models in an actual setting and as a base for training programs for teachers in the technologies.
8. Establish and publish minimum standards for facilities for technology education programs.
9. Establish operational procedures for satellite training centers and programs.
10. Investigate the practicability and potential of utilizing specifically designed mobile technology training laboratories for specialized areas of technology in rural regions.

PROGRAM ORGANIZATION

The nature of the operation of the Technology Education Teacher Center requires an organizational structure adaptable to variable and changing needs. It is neither possible to foresee all the complexities of a teacher center operation nor how best to ultimately organize, control and administer an on-going dynamic teacher center operation. However, there are some constants. The constants are not line and staff constants; they are perceptual constants, constants that result from the way one perceives the function and mission of the Center.

Organizational Structure

The constants determine governance and administrative structures as well as facilities and personnel. Thus, the organizational structure and administrative procedures of the Technology Education Teacher Center are dictated by basic assumptions underlying the technology model and the relationship of these assumptions to the goals and the objectives of the center. The fact that the center's mode of operation is problem-oriented, task-centered and performance-based determines, in large measure, the characteristics of the program and, therefore, the organizational structure and administrative procedures.

In the design of the center, the goal was to move toward an organic model adaptable to specific problems rather than toward a mechanistic model suitable for status quo operations only. The result was the development of what is known as an ad hoc contractual approach.

The ad hoc contractual plan was adapted as the primary mode of operation of the center and thus dictated, to a considerable extent, the organization structure of the center. The plan was compatible with the technology model and provided a flexible and adaptable system capable of meeting immediate and long term needs.

The ad hoc contractual plan, properly managed, adapts to change quickly when contrasted with existing institutional approaches to inservice teacher education in the technologies.

There are many examples of the failure of various institutionalized training and education programs developed two, three or four decades ago. The basic problem is the failure of these programs to come to grips with contemporary problems and needs. They continue to operate out-of-date programs which produce out-of-date people while using limited resources to reach inappropriate goals inefficiently. Contractual arrangements for space, equipment, materials and instructional personnel provide a system superior to the establishment of permanent buildings, staff and programs. Programs based on permanency become dated quickly and, in reality, many times stand in the way of progress, utilizing resources rather than solving problems.

The ad hoc contractual approach is a new approach to educational delivery and support systems for teacher education in the technologies. Several identifiable functional components have been found to be necessary. They are: Management function, training function, contractual function, research function, resource function and evaluation function.

The Management Function

The management function consists of planning, organizing and controlling human and material resources in the execution of a program of action designed to attain given objectives. The balanced interaction of these functions is essential for the attainment of predetermined objectives such as the primary and secondary objectives listed previously. These are identified and program plans developed based on the objectives prior to the initiation of any activities. This assures the fulfillment of the overall purpose of the teacher center program. The management phase includes: (1) Planning, (2) organizing through the establishment of a precise "plan of action," (3) motivating all personnel in the implementation of the program and (4) controlling the operation after it is set in motion to assure that the identified objectives are met.

The planning phase plays a crucial role in the operation of a teacher center program. Each activity of the center involves careful delineation of the task or tasks in performance terms. Each plan of action involves activities in the categories of (1) organization, (2) data collection, (3) analysis, (4) synthesis, (5) proposed solutions and alternatives, (6) application to practice and (7) evaluation. These are management functions as are those associated with controlling, which is based on specific delimited objectives and the development of reward structures and sanctions applicable to specific situations. Also included is the use of proven management tools such as PERT, GANTT, and PPBS, together with techniques such as discrepancy evaluation, trend analysis and management by exception. These techniques fix responsibilities and enable the center to function in an economical and efficient manner.

The Training Function

The training function includes the training of center staff as well as the primary mission of inservice teacher training. Resident personnel at the center and field personnel require continual training in order to carry out the mission of the center. Included in the training efforts are regional trainers, curriculum developers, instructional designers, technical specialists, field instructors and field associates who are classroom teachers selected to serve as field trainers on an ad hoc contractual basis.

The training function is carried out by resident staff whenever possible. Otherwise contractual arrangements are made with qualified personnel.

The Contractual Function

This function consists of two components. One component involves the legal arrangements required for agreements developed between the teacher center and the schools or school systems for given services. The second component involves contracting by the center for specific personnel and other services as required by the contracts with the school systems for training programs and other services.

Included in the contracts are arrangements enlisting the assistance of schools and teachers in conducting experimental and pilot programs designed to develop and evaluate

curriculum designs, instructional designs and training systems. Schools involved in pilot programs become operational technology education pilot programs and training centers. The contractual function thus serves a number of essential purposes including:

1. Visibility of the center's efforts in training, curriculum development and other services by education personnel and others through direct involvement and contribution to the center's program and overall mission.
2. Development of a cadre of teachers as potential field trainers for the center.
3. Development of instructional supervisors as potential managers of the center's field operations.
4. Establishment of a base from which to develop a hierarchy of trainers with various skill levels.
5. Improvement of the nature of the educational system within which the pilot programs operate.
6. Provision of a testing ground, at the operational and instructional level, for continued development of center programs, structures and procedures.

There are several types of contractual programs in operation.

1. Inservice programs of various lengths which provide a series of training programs to selected groups of teachers on selected topics. These are conducted by resident staff of the center and are usually one year in length.
2. Consultant programs which provide weekly inservice programs for two to five teachers for the purpose of developing and implementing new curriculum designs and instructional procedures. These are conducted by consultants employed for a specific school and are usually three years in length.
3. Teaching programs which provide curriculum development and implementation at a given school and grade level. These are conducted by a team of two doctoral level students who design, develop and teach the new curriculum in the contract school.
4. Inservice training programs and workshops. Usually one-session programs conducted by the center staff after school hours, in the evening or on week-ends.
5. Services to schools and school districts in areas such as (a) curriculum design, (b) preparation of funding proposals, (c) course revision, (d) physical facility design, (e) curriculum evaluation and (f) instructional resource planning.

Research Function

The research function of the center involves a wide array of endeavors including: (a) Curriculum design, (b) instructional design, (c) training techniques and procedures, (d) instructional models, (e) evaluation models, (f) value clarification, (g) personnel development systems, (h) technical developments, (i) status studies and (j) projective studies, among others.

The center is also involved in the continual study of technology and technological systems in order to maintain a base for the development of present and future endeavors in improving education in the technologies in the state and region.

Resource Function

This function is served primarily through the Technology Education Research and Resource Center of the Technology Education Program which provides print and physical resources including hardware and software for use by center personnel and teachers from the field who are engaged in pilot or field programs of the center. Included are primary reference and resource materials for the study of transportation systems, communication systems and production systems as well as reference materials for the study of technology and society.

The Research and Resource Center provides services such as information packets which include materials on various new technical materials and devices, portable displays for use in field programs, technology bookshelves for specific technologies and metric resource units.

Evaluation Function

The evaluation function is composed of two distinct efforts. One is the on-going, day-by-day function carried on by the management phase of the program. The other is carefully delineated evaluation research conducted on a contract basis by an outside evaluation team and based on specified program goals and objectives.

The former is based primarily on the Program Evaluation and Review Technique which is used as a management tool. The Program Evaluation and Review Technique (PERT) arranges activities in a logical framework for planning and controlling the opera-

tion and assures that the overall program goals are met within specified budgets and time limits. Prior to the initiation of a program, all major activities (phases) are PERT'ed. Major activities are designated by levels. Time required to complete activities and the resources needed for each are estimated. The PERT operation becomes quite complex and is more efficient if conducted by use of a computer. A short FORTRAN "front end" program is used which matches the data format to that of the center's PERT program. Computer readouts then provide the staff with estimated completion dates for all activities, critical paths and the slack times along noncritical paths. This is done for all levels prior to the implementation of field programs.

Charts are made for each activity and correlated with higher level charts. These charts, together with instructions for use, are published in a Program Planning Guide.

Estimated completion dates, generated through the computer program, facilitate the scheduling of personnel and resources for major program activities. Ancillary or secondary level activities are scheduled by individual staff members who are responsible for the implementation of specific programs.

The PERT planning tool aids teacher center staff in reaching objectives and allows a series of concurrent yet different tasks to be accomplished in a prescribed order. Many individuals and educational organizations are involved in center programs. Planning by the PERT process aids in coordinating efforts and in the fulfillment of the overall functions and goals of the teacher center.

In addition to PERT, GANTT and PPBS, other techniques are used in an on-going management and evaluation process.

Staffing the Center

The success of teacher centers will, in final analysis, be determined by one factor, personnel. This is a critical variable and raises the issue of the characteristics required of staff for teacher centers. Evidence indicates there are at least two broad categories of characteristics. One can be titled "competencies," and the other can be called "perspective." Both are necessary components. The former, competencies, involves skills and knowledge. The latter, perspective, involves attitudes, values and conceptualization.

Past experience indicates that staff for a teacher center involved in pilot programs and inservice education must have a far broader range and depth of skill and expertise than those who have been involved in typical inservice teacher education programs in the past.

The operation of a teacher center for teachers in the technologies is complex. The primary mission is training. The primary organizational plan utilizes a technology model. These two factors relate to the second category of characteristics required by teacher center staff — namely, attitudes, values and conceptualization. Unless the commitment of the staff to the training function is explicit and firm, the center cannot be successful. The function of the teacher center is not to duplicate the research and instruction of preservice teacher education programs. The function of a teacher center is training.

In addition, unless the staff comprehends and understands the technology model and utilizes precisely planned and executed training programs based on explicitly stated objectives, the teacher center program will not be any more successful than typical inservice programs. How the staff conceives the center and its mission and their role as a part of the mission will determine to a considerable degree the success of the center. The other variable is the requirement that the center staff be skilled, that they have the basic competencies necessary to function in a highly complex environment.

Staff training is an essential ingredient to the continued success of a teacher center. The entire operation requires the establishment of well defined goals, detailed planning and skillful implementation. Each phase requires highly trained individuals. This implies that personnel functioning as staff of the center are involved in continual training. One of the myths of the educational profession in the past has been that credentialed individuals were qualified individuals. Experience with the operation of a technology education teacher center has proven this assumption false. Therefore, not only must the center be structured to meet the needs of its clients, it must also be structured to provide on-going training programs for center personnel and others associated with the program. Without this component, evidence indicates that the effort will not be successful.

Facilities

The need for physical facilities varies with the on-going programs of the teacher center. There are, however, two types of facilities as well as several constants which

provide a base for determining minimal facilities. The two categories of facilities are field (on-site) facilities and center facilities.

Field facilities are those facilities which the center utilizes on a contractual loan or lease basis, either for short terms or long terms, depending on the type of program in which the center is involved. Ordinarily the center utilizes classrooms or laboratories although private, public school or community resources are also potential sources of facilities and have been utilized.

Center facilities are those facilities the center utilizes on a permanent base for day-to-day operations. Based on experience, minimum facilities for a technology education teacher center should consist of:

1. Management Function Facilities.
   a. Office for Center Coordinator.
   b. Planning facilities.
   c. Conference facilities.
   d. Secretarial and clerical facilities.
   e. Communication facilities including duplication facilities.
2. Training Facilities.
   a. Instructional facilities for staff training and resident inservice training programs.
   b. Mobile laboratories to provide for specialized field training needs.
3. Research and Resource Facilities.
   a. Technical laboratories.
      (1) Development of instructional materials and devices.
      (2) Testing of prototype instructional devices.
      (3) Testing of instructional strategies with children.
      (4) Development of laboratory designs and arrangements for programs of instruction.
      (5) Teaching of technical skills for inservice programs.
      (6) Teaching of technical information for inservice programs.
   b. Resource Center.
      (1) Curriculum development materials.
         (a) Basic reference materials.
         (b) Technical publications.
         (c) Curriculum guides.
      (2) Publications—technical.
         (a) Production Systems.
         (b) Transportation Systems.
         (c) Communication Systems.
         (d) Energy.
         (e) Materials.
         (f) Periodicals.
      (3) Publications—social/cultural.
         (a) Historical Studies.
         (b) Technology and Society.
         (c) Technology Assessment.
         (d) Technology Forecasting.
         (e) Technology and the Future.
         (f) Periodicals.
      (4) Publications—professional.
         (a) Curriculum Development.
         (b) Instructional Design.
         (c) History of Education.
         (d) Education Research.
         (e) Sociology of Education.
         (f) Philosophy of Education.
         (g) Periodicals.
      (5) Instructional Materials and Devices.
         (a) Films.
         (b) Transparencies.
         (c) Slides.
         (d) Film strips.
         (e) Instructional kits.

(f) Games.
(g) Simulations.
(h) Videotape cassettes.
(i) Audiotapes.
(j) Charts.
(k) Pictures.
(l) Precision teaching-learning units.
(m) Vertical files.
(n) Other.

(c) Computer terminal.
(a) PERT programs.
(b) Wylbur programs.
(c) Literature search, ERIC, etc.
(d) Research data.
(e) Statistical analysis.

PROGRAM OPERATION

The objectives of the center, together with the organizational design developed to attain the objectives, determine the operational style of the center. Operationally the Technology Education Teacher Center can be best described as a complex multifaceted program with numerous major endeavors, including:

1. Regional inservice teacher education programs.
2. Field associate training programs.
3. Contractual precision teaching-learning unit development programs.
4. Experimental elementary school technology programs.
5. Cooperatively formulated contractual programs for the development of new curriculums and instructional programs for school systems.
6. Special workshops on:
   a. Metrication.
   b. Elementary school technology.
   c. Unified arts.
   d. Transportation technology.
   e. Communication technology.
   f. Production technology.
   g. Aerospace education.
7. Administrators' Information Meetings on Technology Education.
8. Technology Education Research and Resource Center Development.

All the programs conducted by the teacher center have been initiated and conducted cooperatively with the state department of education through the program specialist for industrial arts who serves as a liaison between county school systems and the teacher center.

The operational mode of the center is also influenced by research findings on change and the change process. For instance, there are several conditions affecting educational change which dictate the operational procedures and structure of the center. It has been found that the change process is enhanced when the following variables are operating:

1. Participants are involved directly in the change process.
2. Participants receive immediate feedback of the consequences of their behavior.
3. Activities are perceived by the participants to be relevant to their needs.
4. Learning activities are obviously carefully designed and directed to the attainment of established purposes.
5. Learning activities are reinforced by application to practice in actual field settings of new content and instructional strategies as part of the change process together with direct support from center personnel during the application effort.

Other findings related to the change process which affect the operational mode and structure of the center concern educational personnel other than teachers. Analysis of research findings and experience with pilot programs in actual practice indicate that the

involvement of chief school administrators, curriculum specialists and principals is imperative if organized change is to occur.

Operationally, then, it is essential that the plans, procedures and activities of the center involve these educators in the change model. For example, experience in the operation of the center has indicated that the following factors are critical:

1. Analysis of the role of administrators, including superintendents, supervisors, curriculum directors and principals is required to determine the level of involvement of each in determining direction for change in the local system.
2. Determination of inducements which create a personal commitment for planned change on the part of administration is critical.
3. The sharing of the responsibility for change by all administrators is necessary if change is to become a continuous process.
4. The commitment of administrators is critical if teachers implementing change are to receive the support necessary to assure success of the planned change.

In addition to these factors being essential in initiating planned change, adequate patterns of communication have been found to be necessary to guarantee a continued functioning of the change process.

Operationally, the program specialist from the state education department has been instrumental in establishing initial communication links between the teacher center and local education agencies and individual classroom teachers. Developing and maintaining communication with the field, once contractual arrangements have been completed, is the function of the teacher center coordinator. During the operational phase of each project, all standard communication techniques are utilized including letters, reports, telephone reports, newsletter and field meetings.

In addition, the general mode of operation includes weekly planning and debriefing meetings by the center staff where each project is discussed and actions initiated.

Operational Financing

The Technology Education Teacher Center has been supported from four sources since 1970. The primary source has been the United States Office of Education. Other support, in decreasing amounts, has been from contracts with: (1) Local school systems, (2) the university, primarily in the form of physical facilities and part time personnel and (3) the state department of education, both monetarily and through support personnel.

At the conclusion of the fourth year of operation, the center reached the point in its development where the possibility of a self-sustaining operation, one without direct grants, was possible. At no time during the development of the center have direct yearly grants exceeded 45,000 dollars. The range has been from 18,000 to 45,000 dollars. The past two years of operation have provided evidence that the contractual mode of financial support will provide the center with the means of attaining self-sufficiency.

Operational Staffing

The teacher center has been staffed, with the exception of the last two years, by part-time personnel. In 1973 the University created a full-time position, called the coordinator of field service programs, for the Technology Education Program. The teacher center is the field service operation of the Technology Education Program.

All other staff positions, with the exception of a full-time clerical position, have been part-time positions held by doctoral students in the Technology Education Program. This arrangement has not been entirely satisfactory, primarily because of the limited time part-time staff have for field work, a major element in the technology education teacher center model. Therefore, future plans call for the establishment of at least two full-time technology education extension positions.

ASSESSMENT OF THE TEACHER CENTER OPERATION

A critical review of the organization and operation of the Technology Education Teacher Center leads to the conclusion that no large scale success has been attained. Significant numbers of teachers have not been retrained. Nor have large numbers of new curriculum development programs been initiated in public schools. What success the center has had has been in the development, implementation and testing of a new delivery

system for educational change in the technologies — a delivery system which has been proven, in a series of pilot programs, to be highly effective and for several specific reasons. The prime reason for success of the pilot efforts was due to the design of a model which called attention to variables such as problem identification, performance objectives, planning, task analysis, immediacy, application to practice, evaluation and personal involvement, all factors critical to the change process. The focus of the teacher center operation on change and the change process, together with basing the design and application of the center's programs on research on change, provided a set of criteria by which the center's programs could be designed and from which success could be measured.

The entire process of the inservice teacher education effort was, therefore, change-oriented. The criteria for success was whether the objectives were reached and whether the planned-for change took place. These have been found to be critical factors if valid improvement of the teaching-learning process in the technologies is to be attained. It was learned, for instance, that the most effective conditions for dealing with change occurred when participants in inservice programs:

1. Were directly involved in dialogue, discussion and planning of their program of study.
2. Received immediate feedback of the consequences of their behavior.
3. Perceived the activities to be relevant to their concerns.
4. Were aware that learning activities were carefully designed to accomplish clearly conceived purposes.
5. Were aware that the efforts of the program focused attention toward the ultimate goal of field application.

These and other criteria are factors requiring consideration in the planning of any successful inservice program.

The Technology Education Teacher Center at West Virginia University has designed and tested a model which has the potential of providing and sustaining inservice education for teachers in the technologies. The organizational and operational patterns have proven to be effective in meeting the educational problems of a changing technological society. During the past five years the center staff, utilizing a teacher center design based on the technology model and research on change, has been able to accomplish the following:

1. Motivated individuals toward continuous learning and the maintenance and improvement of their competencies in the technologies.
2. Designed a flexible and adaptable structure capable of meeting the needs of educational and technological change.
3. Developed a model capable of serving the needs of individuals or groups within a local community, at regional centers or at the university center depending on need, complexity of instruction and resources required.
4. Developed a model for short-term training and retraining programs for teachers at all levels in the technologies.
5. Developed procedures for contractual arrangements with schools and county education systems in fulfilling needs for curriculum design, instructional design, inservice education and other related efforts.
6. Served as an outside force for aiding personnel and schools in the design and implementation of change.
7. Developed a model for the identification, design, development and delivery of teaching-learning units for improving classroom instruction.

The teacher center is more than an alternative to traditional inservice programs. It is, in fact, a totally different type of organization which has the potential of fulfilling long-standing needs of inservice teachers. As such, the teacher center concept may be the missing link in the teacher education process — namely, the training function. Properly conceived, organized and operated, the teacher center has the potential for bridging the always present gap between theory and research and practice. If this ever present gap can be bridged, then there will be an increasing probability that education of young men and women in the technologies and other areas of the school curriculum can and will be improved. To do so, however, will require more than the singular effort evidenced by this report. What will be required is the multiplication of the effort by those interested

in change, those committed to training, those committed to field work and those committed to planning and the objective form of management. If individuals with these commitments begin the development of Technology Education Teacher Centers with the eventual goal of a network of centers nationally, then there can be a significant improvement of education in the technologies.

The authors of this report would be pleased to hear from individuals interested in teacher center development.

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Technology as Content: Can Teacher Education Cope?

Donald P. Lauda

> So far as the mere importing of information is concerned, no university has had any justification for existence since popularization of printing in the fifteenth century. ALFRED NORTH WHITEHEAD

This presentation, as indicated by its title, deals with the future. Its intent is to seek plausible solutions for determining instructional content and instructional strategies for teacher education programs. This theme is a critical one as our society advances into the postindustrial era. The title implies several basic assumptions which are crucial as persons with various philosophies seek the optimum program for teacher education in industrial arts.

These assumptions are:

- That the term technology is capable of being defined.
- That technology has permeated our society and is therefore worthy of consideration for curricular efforts.
- That the industrial arts profession might not be able to withstand the complexities of a technological society.

Since the late 1960's industrial arts educators have made a concerted effort to generate programs based upon the study of technology. This movement has met resistance in many cases. The debate has been enhanced by those who feel that the term cannot be defined, by those who choose to place an adjective in front of the term (e.g., industrial technology) and those who totally reject the study of technology as a discipline base. The reader is encouraged to read the proceedings of the 32nd AIAA conference held in Louisville in 1970. In this volume (pages 187-221), no less than 13 educators discuss the issues in great detail.

Our first assumption — that technology can be defined — causes the greatest debate. Countless definitions have been offered by persons in many different disciplines. One consistent thread seems to permeate these, and that is that technology is a process. Berger's definition (p. 191) probably summarizes this concept. He says:

> Technology is a field of systemized and accumulated knowledge, techniques and intellectual skills and their practical application in creating useful goods and services for mankind. This body of knowledge is derived from a detailed study of the nature, principles, practices and products of science and industry. It is interdisciplinary in nature and involves the application of most of the other disciplines in the solution of technical problems.

These definitions, including the one by Berger, reveal many other relevant consistencies. Among these are:

- Inherent in the concept is human endeavor, that is to say that the products (and by-products) are created by humans.
- The result of the technologies is apparent in all cultures regardless of their age or stage of development.
- The technologies are based on the accumulation of knowledge which fosters the innovative process.
- The technologies have an impact upon all disciplines.
- The technologies are a viable content source for industrial arts.

With these in mind the author offers the following definition for the term technology:

> A process undertaken by humans in all cultures (a cultural universal) which involves the systematic application of organized knowledge (synthesis) and tangibles (tools) for the perpetuation of their culture and society; the study of which must include an understanding of technical information, the innovative process and the concomitant socio-cultural impact.

The writer runs the risk of merely offering another definition which reeks with philosophical overtures but offers little rationale for altering traditional industrial arts. Therefore, it is necessary to elaborate on the definition, with the intent being to show that the study of technology (without a modifier) is viable and necessary if we are to prepare students for their future.

INVENTORY OF A CULTURE: A MEANS TO IDENTIFY REALITY

Curriculum theorists have consistently expressed the need to base teaching efforts on the realities of our culture. Today the futurists are going one step further and telling us that it is the reality of the future that we must utilize as our base. Our culture is a social environment which evolves from human needs and competes with the physical environment and, in some cases, other cultures. New practices arise; if they contribute to the survival of the culture, they become constants (universals).

All cultures pass through many contingencies. These interdependencies and interactions inevitably lead to strain at two levels: Between the old values and new values and between different groups of people. Coping with this rapid change faces every person, and it is the institutions which must give coping mechanisms for human survival. The educational system is in a key position for assisting in that process.

In 1976 the citizens of the United States live in the most highly developed nation in the world. Opportunities for the utilization of the most sophisticated innovations are in

evidence. Granted these opportunities are not provided to all people, but these are social not technical issues. The point being made is that the process we call technology has advanced our technical expertise to the highest level evident on earth. Historians can provide many reasons for this fact. However, what is important is that our students cannot escape the technical and social growth of their culture. This growth is perpetuated by many factors, such as:

- R & D Funding. Fiscal year 1977 research spending with federal funds should increase 11 percent to a high of 24.7 billion dollars. Industrial Research magazine (Jones, p. 54) indicates that the total research budget in this country should reach 34 billion dollars.

- R & D Technique. Corporate research has taken over the innovative process in the growth of science and technology. Enhanced by phenomenal assets and access to information systems the super-corporations can expedite the innovation process. It is estimated that by 1990 a handful of super-corporations will produce over three-fourths of the United States GNP.

  Schoenholz and Terry (p. 60) report that of the 237 notable inventions starting with the screw for pumping water in the third century B.C. to inventions in 1943, literally every one was invented by one, two or three individuals. However, when considering 15 of the most notable inventions between 1944 and 1960 we find that 10 are attributed to large organizations. The lessons of team research have been providing the impetus for rapid growth in the technologies.

- Information Systems. Keeping in mind that the process we call technology "feeds" on accumulated information, the reader must realize the magnitude of the world's knowledge. For example, the Library of Congress (Miele, p. 24) had accumulated by June 30, 1974 over 73,932,425 items. These holdings increase at the rate of two million per year.

  The authors of the volume referred to above (Bowker Annual of Library and Book Trade Information) emphasize the point that the knowledge explosion is so immense that the only means to cope is via collaboration with specialty libraries. Page 351 of this volume discusses the global scene when it refers to the 60,000 scientific and specialty libraries in the USSR.

- Interdependence. Due to the realization that we exist in the midst of "finite resources" and "infinite demands" vast expenditures in the science and technologies will be utilized to ensure survival. Reference is made to international ventures to generate and control the technologies.

It would be easy to continue this list to emphasize the highly touted growth of our technological prowess. Today this seems almost passe. One would have to be comatose in order to avoid conscious awareness of the realities of our culture. Perhaps the problem in our discipline is that the degree of awareness stifles curricular efforts. In any case, at this juncture the writer wishes to function with the assumption that:

- We live in a culture which is perpetuated through the human use of accumulated knowledge and tools.
- The process called technology will continue to escalate exponentially leaving our products (students) living in a culture unlike that of today.
- Humans are as much a product of their culture as of their genes.

COPING

It was stated in the beginning of this paper that the theme of this session assumed that industrial arts educators might not be able to cope with the technology of the 1970's and beyond. It is important to note that the writer says that educators might not be able to cope rather than saying industrial arts can or cannot. Industrial arts, like technology, is neutral. It is the human who creates. It is the human who must cope. Industrial arts is only what we make it.

What does it mean to cope? What does it mean to say that we can or cannot handle the exigencies generated by rapid change? Commonly, coping refers to dealing with the things as they come or keeping equilibrium. Encounters require strategies for working out modes of adaptation. These require conscious consideration of needs and demands of the situation. Coping behavior can best be defined as purposive action designed to assist

in adjusting to environmental circumstances. It does not consist of withdrawal from reality. Coping behavior thrives on informed understanding of the environment and the ability to distinguish between the possible and impossible.

To say that teachers in the discipline of industrial arts cannot cope with the technologies would imply one or more of the following:

- Technology is so vast, so complex and so bewildering that no human can hope to understand its nature.
- Educators are incapable of seeking modes of adaptation.
- Educators are totally divorced from the realities of the world.
- The study of technology never has been, and never will be, the goal of industrial arts.

Each of us has heard these noncoping expressions over and over again, especially the first and last statement. Psychologists refer to this as expressive behavior rather than coping behavior. Teacher educators have not been afforded the opportunity in many cases to explore the realities of our technological culture. Noncoping expressions, therefore, are expected. These problems are not indigenous solely to industrial arts teachers. Other disciplines are experiencing the frustration of keeping pace with the world's technical knowledge which doubles every decade.

If educators agree that content should be derived from our culture and that we live in a highly technologized society, they either address themselves to that technology or lose the right to condemn those who do. They also lose the right to perpetuate education for the past which most assuredly will be detrimental to the citizens of the 21st century. Since the "system" has created this dilemma, that is, placing the content and instructional strategies of industrial arts educators in a "holding pattern," it is the educational arena which has tolerated noncoping behavior. Educators are not at fault. This is what they were taught. Streichler and Ray (p. 27) put it on the line when they stated:

> Finally it is suggested that effective curriculum planning cannot be elicited from educational leaders who are captives of traditions, modes of thought, heritages, and value systems which are irrelevant to contemporary society and are incomprehensible to the youth of today. The determination of industrial arts content should not be rooted in the past, but should develop fresh stems to search out needs, tools, patterns, and future-oriented values.

The writer does not mean to imply that industrial arts is due for extinction. The implication is that it is in the most opportune position of its tenure. No discipline is addressing itself to the concept of technology from a technical and socio-cultural standpoint in the public schools. Yet millions of youngsters are being educated to survive in the inevitable technological society. They cannot escape this position. Keep in mind that the six year old of today will be thirty in the year 2000. The tools we give him today are supposed to prepare him to face that century.

Most curriculum projects in our discipline have dealt with the study of industry. Some projects advocate the study of industrial technology, finding the word industry too restrictive. Still others tout the study of technology without any modifiers. It is here that the debate begins. It is here that the question of whether industrial arts can cope takes on real meaning. On one hand the use of a modifier (e.g., industrial) implies the inability to cope with the totality called technology. On the other hand, one is left with the impression that all technical knowledge and the sociocultural consequences can be compressed into a curriculum package. This appears to widen the philosophical chasm in the discipline of industrial arts.

Inevitably one must do his homework and take a stand on such an issue. One runs the risk of being chastised by his colleagues, but healthy interchange of ideas is the only means of getting our discipline to pull together. To this writer it appears that our technological culture is so complex and so impregnated with the impact of technology that helping youngsters understand the interrelationships must be our priority. To isolate the study of industry as our discipline base denies the student the right to see the relationships of the major endeavors of the human. Reference is made to those human activities which are constant in all societies (production, communication and transportation). Our society is now into the postindustrial revolution, thus making Ferkiss' technological

myth now a reality. To discuss and experience the industrial enterprise of the 1960's does not even portend to acknowledge the movement from a goods producing economy to a service economy. Nor does it acknowledge new occupational structures or the axial principle of knowledge. The postindustrial revolution thrives on theoretical knowledge to perpetuate its growth. Therefore, work becomes knowledge based. Students need to learn how the knowledge in the technologies is stored, retrieved and utilized.

To many the study of technology appears to be an impossibility since it is so vast. They say one cannot teach all of the areas (e.g., medical technology, social technology, nuclear technology). With these expressions it becomes apparent that the concept of technology is completely misunderstood. To refer to specific technologies results in the use of modifiers once again, just as does the name Industrial Technology. It is imperative that the educator realize that technology is a process rather than a "thing." The formal definition presented earlier in this paper was:

> A process undertaken by humans in all cultures (a cultural universal) which involves the systematic application of organized knowledge (synthesis) and tangibles (tools) for the perpetuation of their culture and society; the study of which must include an understanding of technical information, the innovative process and the concomitant socio-cultural impact.

Once we move into this mode of thinking our goal becomes one of interpreting the following:

- What circumstances led to the development of our technological culture.
- What was the innovative process for generating ideas, tools, etc.
- How did/does the identified innovation function (technically).
- What contribution did the process have on culture and society.
- What is the future impact of our actions.

AN APPROACH

The debate over approaches reaches its greatest impact level when the realities of teacher education are confronted. Those who identify with the study of industry have the security of recent experience and facilities designed for that purpose. Whether or not the addition of the word technology to the word industrial accommodates the mandates of a technological society is mere conjecture. In any case the burden of proof seems to lie on the proponents of the Study of Technology as a discipline base. Inevitably the call comes for an end to the philosophical statements with a request for the identification of content and instructional strategies.

At Eastern Illinois University we have adopted the Study of Technology as our discipline base. This program will be implemented in the fall of 1976. Like technology, it is assumed that it will be a model which is constantly changing and adapting to new information. Those who have worked as a change agent in curriculum modifications realize that each situation has specific constraints (e.g., certification laws, facilities, budgets). The reader should keep in mind that the program was designed to accommodate those constraints which could not be changed. An overview of the program follows.

It is obvious that traditional laboratories would not handle the proposed program. Therefore, large open-space laboratories are being developed to accommodate the systems approach in each area (production, communication and energy). These laboratories will be utilized via a team-teaching approach utilizing two faculty members and one graduate assistant. The utilization of equipment and materials is planned to be carried out in a flexible atmosphere (e.g., movable equipment). Long range plans call for a learning resource center to accommodate individual needs. The three main laboratories will be open during one-third of the available time for seminars, individual research, skill development, tutoring and related activities. During this time no classes are scheduled and each laboratory will be staffed. Thus, the laboratory serves as a learning center to accommodate students when they need assistance.

A number of preliminary outcomes have been realized even though the new program will not begin for four months. A few of these are:

TECHNOLOGY EDUCATION AT EASTERN ILLINOIS UNIVERSITY

TITLE	DESCRIPTION	S.H.
CORE		
Technological Systems	Introduction to the Study of Technology, including the evolution, current status and future of the areas of technology: production, communication and energy.	3
Materials and Processes	Study of the processing of materials used in technical endeavors; natural and synthetic.	4
Communications Technology	Interrelationship of operations in graphic communications.	4
Energy Technology	Study of the processing, converting, transmitting and controlling of energy sources.	4
Production Systems	Study of the necessary systems for designing and producing in the areas of manufacturing and construction.	3
Computer Programming	Introduction to computer programming	1
Trigonometry	Self-explanatory	2
Physics/Chemistry	Self-explanatory	7
Professional Sequence	Self-explanatory	23
Ascent of Man	Development of science and technology	2
Technical Concentrations (2)	Advanced level work in technical areas	12
	Subtotal	65
GENERAL EDUCATION		
Hours distributed throughout English, Speech, Health, Humanities, Social Studies, and Mathematics/Science		37
*TOTALLY FREE ELECTIVES		18
	Total	120

*Includes such courses as Readings in Technology, Alternate Energy Sources and specific advanced technical courses.

- Interest expressed by other disciplines for joint ventures in providing instruction.
- New courses are being accepted in other disciplines to support major requirements in those disciplines.
- Utilization of at least one course (Technological Systems) to meet University general education requirements.
- Unsolicited support given by the University Library to assist in the new program.
- The up-dated undergraduate program served as a springboard for revising the Masters program. This has been approved and will also begin in the fall of 1976.
- Renewed interest in the program by the public schools.

The end product will be the true test for this new program. One may logically ask why the student will be different than one from a traditional program or one from a program exemplifying the 1960's. This question can only be answered by the students who eventually will be taught by the new type of teacher. However, a number of assumptions can be made, such as:

- The curriculum is an attempt to present the realities of our culture (technology) without being restrictive. The student will be exposed to the gestalt of the concept rather than to an isolated part.

- The curriculum addresses itself to the socio-cultural aspect of technology as well as to the technical component.
- The curriculum allows for individual differences and enables each student to engage in study relevant to his/her needs.
- The curriculum is future-oriented. That is, it engages questions pertinent to our technological future.
- Education will be dispensed and acquired through a multiplicity of means.
- Students will be able to move within the system, both horizontally and vertically.
- Barriers to learning, common in traditional programs, have been removed (e.g., obsession with projects, knowledge geared to the past).
- Graduates will receive their B.S. degree as educators rather than as specialists.
- The graduate will understand his culture: Its conception, the innovative process which perpetuates it (technology) and will visualize the importance of imparting this to children of the future.
- Students will work in an atmosphere resembling a technological environment (e.g., flexible, efficient, future-oriented).
- Graduates will be responsive to the needs of the clientele they serve. They will be able to cope with diverse models of instruction. More importantly they will be able to provide viable input for change.
- Students will see their discipline based on a process rather than on segmented and seemingly unrelated elements.

CONCLUSIONS

Industrial arts teachers and teacher educators can definitely cope with our technological culture. There is identifiable content in the technologies which needs to be presented in a form capable of behavioristic interpretation. The newborn child grows up in a technological culture and must be raised to cope with its mandates. The industrial arts profession is one of the very few disciplines in a position to engage in such education. Although geared to out-dated production systems in many cases, the profession is involved in the three identified areas of technology (production, communication and energy).

The world is facing many serious problems which will require a combination of technical and social solutions. Reference is made to overpopulation, energy needs, diminishing finite resources, the international quest for affluence, the interdependence of nations, the impact of multinational corporations and the total concept of cybernation. To understand one's place in this mosaic seems almost incomprehensible. That mosaic was painted within the past few decades via the accumulation of knowledge and we now need to visualize it as a cultural determinant. The concept of rapid change will not diminish but will continue to escalate. Making sense of this is what the enculturation process we call education is all about.

Teacher educators have been bandying the issues long enough. No longer can the debates take place over definitions, over philosophical overtures or over irrelevant "cop-outs." The youth of today realize that they live in a technological world. They are asking relevant questions at a very early age concerning their culture. To answer them via models of the past does little to help their future-focused role image. The term technology is part of their everyday vocabulary and most certainly is here to stay. The literature is replete with discussions of adaptation to the technology as well as every form of mass media. Even our own journals have adopted the jargon of the technologies. It is time that educators identify with the culture of the present and the needs of children of the future. To reject the study of technology is to reject the needs and desires of humans. To present out-moded models cannot survive through this century.

A CALL FOR HELP

It appears to this writer that it is time for the industrial arts profession to pull together to identify content and instructional strategies which will accommodate the needs

of humans. Many institutions have programs which are utilizing the study of technology as a disciplinary base. This number is increasing rapidly, thus leaving many programs making the same mistakes. Therefore, I propose that a consortium be established of industrial arts educators who are able to leave personal biases out of curriculum change and who wish to explore the utilization of contemporary and future technology within industrial arts education. This group should engage in professional dialogue to share ideas on a nonthreatening basis, seek to share ideas rather than hoarding supposed "ultimate answers" and then report to the profession their conclusions. I would suggest that the ACIATE is the logical group to establish such a consortium. Through this process we can end many of the semantic debates and move forward. Let us face it; we need each other. Let us face it; there are no best answers; there are only alternatives.

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Technology as Content: Can Teacher Education Cope?

Donald G. Lux

The teacher education profession responds to innovation in two major ways. The first of these may be called "the add-on approach" and the other requires reorganization.

The attractions of the add-on approach are that it: (1) Causes a minimum of trauma, (2) defers major decisions, and (3) easily gives the appearance of change without requiring a major commitment to it.

Its weaknesses include, for example, that it: (1) Fails to address the basic problem (the continuation of obsolete and inefficient programs and program elements), (2) tends to cause innovation to be a divisive rather than a unifying concern, and (3) leaves the innovator in a tenuous position.

The strengths of reorganizing are that it: (1) Focuses total attention on innovation, (2) tends to cause assessment of all program elements and the rejection of the least defensible of them, and (3) causes resource allocation to be made where it ought to be.

Its weaknesses are that it: (1) May slow change because of the need to wait out new developments in order to avoid premature commitment to short-lived pressures, (2) reduces the ability to respond to traditional needs during the transition period, and (3) creates an atmosphere of, "Why excel at this when tomorrow we will again need to change?"

What has happened with regard to IACP's impact upon teacher education is a classic case in point. Some colleges and universities have simply added The Ohio State-designed inservice workshops as preservice add-ons. Others have seen that as an indefensible response to the basic problem and have seen the preservice need as a far more complex one, with the result that they have reorganized total programs or at least major portions of them.

Fundamentally, how much one tries to maintain drafting, woodworking and metalworking as a basic core to be maintained against any and all change efforts depends upon how much one believes that industrial arts subject matter is based within what tradesmen know and do. If one sincerely holds that industrial technology is the subject matter, then rapid and total teacher preparation program reorganization is called for most urgently.

Simply accepting the need for program reorganization does not assure success. In fact, it may, for marginal programs, dictate that they should close. But is that all bad? Even for many of the largest and well-supported programs there are likely to be serious problems.

Industrial technology, according to any adequate definition, requires expertise far beyond the traditional kinds found in custom-handicrafted production. At the least, it includes all types of engineering, product and architectural design and industrial management. In addition, it suggests the need for unusual strengths in related disciplines such as industrial sociology, industrial psychology, labor and economics. Few of our present teacher education institutions now have available these resources within their total campuses, let alone in their departments.

What this seems to suggest is that the respective states need to study seriously the questions related to answering "how many programs the state can support and where they should be located" in light of the expertise needed for the adequate teacher education programs for the 1980's and beyond. It also suggests that ACIATE ought to study ways in which it could exert national leadership by accrediting, or at the least recognizing, only those programs which have technology-based curricula for the preparation of industrial arts teachers, along with adequate support personnel of the type just noted.

Since the overwhelming part of teacher education faculties are now products of a handicraft-based program, much effort needs to be devoted to inservice seminars, conferences and training sessions which communicate basic industrial technology knowledge and skills. It means of course we also might seriously question a continuation of special interest sessions or demonstrations on such limited concerns as metal spinning, leathercarving, woodturning and silk screening.

There are many widespread shortcomings and inadequacies in industrial arts teacher education. These problems will not be satisfactorily ameliorated by adding on to trade-based programs selected courses in manufacturing, construction or communications, for example. Also, they will likely be overcome only with comprehensive inservice education

for present faculty. We do not now possess the expertise which is required to cope with the problems which confront us. Massive inservice staff development and total preservice program reorganization are called for.

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Some Highlights in the History of Technology

Clifford G. McCollum

As a science educator and as one interested in the history of science and the impact of science upon human affairs, I am having increasing difficulty distinguishing between science and technology as they manifest themselves in modern times. This is particularly true insofar as their goals and methodology are concerned. Melvin Kranzberg, the historian of technology, distinguished them by characterizing science as the "know-why" and technology as the "know-how."[1] However, there have been so many developments within our time where this distinction blurs and even becomes meaningless. The Manhattan District Project of World War II and the NASA projects of the past 1-1/2 decades come immediately to mind.

Therefore, I rationalize that I have a degree of legitimacy in discussing with you some of the highlights in the history of technology. Such highlights are a part of the heritage with which technologists operate. Cognizance of this heritage may give us a healthier perspective than we often have in contemplating the future in which the influences of technology upon human societies are alternately lauded and damned.

Technologists and technology educators stand on prominent pedestals in western culture. The demand for increased and improved "know-how" accelerates. Yet with the demand comes heightened and more impassioned criticism. Those pedestals are not comfortable places to be. As William Irwin Thompson expressed it a few years ago, technology stands at the edge of history. It rests upon the developments of the past. It has capabilities for tremendous influences upon what the history of tomorrow will be. Culture will be transformed. That transformation may very well involve revolution in human goals, values, and relationships. The technologist of this day — such as the engineer, the physician, the agriculturist, the architect — cannot disclaim his responsibility. And the teacher in technical education is especially challenged. Standing at the edge of history, what are we doing to tip the sequence of events in mankind's favor?

Thus, I propose to play with some thoughts which tie the ideas and victories and disappointments of the past with our present estate and use this relationship to suggest respect for the future. Further, I believe the knowledge of and the sensitivity to these relationships are important possessions of the researcher in both technical education and science education.

Evidences of the pervasiveness of technical change through our daily lives are so often recited that one runs the risk of becoming flagrantly tedious in even referring to such in a summary fashion. Recognizing such a risk, I nevertheless dare suggest for the purpose of this paper that the social impacts of this diffusion have had both their positive aspects and their negative ones and some that are indeterminate.

Urbanization, with all of its advantages, as well as all of its blights and problems is, of course, closely associated with industrial process. When manpower provided the principle source of energy for the fabrication of material into desired products, the home was the primary site of the manufacturing operation. Manufacturing was truly a fashioning by hand. There were many advantages in a certain degree of dispersion of these small industrial sites. But as hand power and animal power came to be replaced by water power, there was necessity in locating mills along rivers and in certain favorable spots. This tended to concentrate industrial operations. Improvements in water wheels by Parent and Smeaton and others concentrated them more. It wasn't economically

possible for every home loom to be powered by its own overshot water-wheel. And when Newcomen's and Watts' steam engines and their descendants began to turn the machines of man, it became important to locate them in population centers. Urbanization is an essential part of the industrial revolution. Technology of steam power triggered it and when the blight of the factory and the slums of the inner city reduced the quality of life, the technology of transportation, primarily that of the automobile, supported the flight to suburbia. In contrast, the modern technology of agriculture is dispersing rural populations or even destroying them. In either case, it is evident that industrial technology is intimately associated with urbanization and population distribution patterns and with the life styles they generate.

Changing agricultural technology has contributed to a variety of social pressures and problems. In this change in our nation's experiences, many ethnic minority groups have not been favored. The cotton gin put even greater pressure on the slavery system of the South which was responsible for the field production of the cotton. The resultant business relations between the North and the South deteriorated into the Civil War. The economic deprivation of the blacks of the South has been intensified as the increasing mechanization of agriculture has replaced the field laborer. Add to this the availability of cheap transportation through the technology of the automobile and those replaced moved to industrial centers without quality employment and crowded together in housing already deteriorating and subjected themselves to a vicious economic exploitation. Thus the ghettos were spawned and grew and life within reverted to a brutality not unlike that in a more primitive past. Many in this condition cannot compete with the skill of the machine of modern industry and their animal power is not needed. The oppressed of the plantations of the past have become the oppressed of the modern city. Many other ethnic groups have suffered similarly.

The ubiquity of the automobile in our day is nearly matched by that of the television receiver. Sociologists are still describing the tube's impact upon our society in terms marked by great ranges of uncertainties. However, life in the American family has unquestionably been changed. The war in Vietnam came into millions of homes in living color — blood ran red from both American and "gook." We all participated in this war in a way in which a populace never had before. And war was hell! And why were we involved in it anyway?

And the people in the ghetto saw that same war through their TVs too, albeit not so often in living color, and they saw more of their "kind" involved than they saw from the suburbs and they saw life being lived in a way in which they weren't living, and couldn't live. The oppressed, the young, the parents of the young, they all exploded with their restlessness. They marched in the streets, they rioted, and the TV's showed them on their screens. We finally admitted we could lose a war, and we developed somewhat more of a social consciousness, but we've a long way yet to go and the intensity of our senses of social justice rise and fall in irregular cycling. I dare suggest th eye of the tube was an important contributor to the unrest of the late 1960's and early 1970's and that it will continue to be an important instrument involved in the social relations of man.

It has been suggested by many that the liberation of the middle-class woman in the 20th century has been greatly facilitated by technology. A factor often referred to is her increased mobility which has enabled her to express her individuality in a wider variety of situations through the use of the automobile. Although it becomes increasing evident that the female is not the "weaker sex" in any mode of reference, Charles Kettering's invention of the self-starter in its time undoubtedly contributed greatly to putting women in the drivers' seats of the burgeoning numbers of "flivvers." Although suburban housewives with responsibilities for transportation of family members may not look upon the automobile as a liberator, it certainly has removed restrictions of time and space that would have reduced the thrust of many aspects of the feminist movement. The influence of other gadgets and tools and appliances can, of course, be similarly postulated. The modern American housewife probably makes more use of a wider variety of machines than the average male. If the parameters of the definition of technology permit the inclusion of such applications of chemistry and human biology as the "pill," then technology takes on even more influential contributions in the liberation of women in our society. The great-great-grand-daughters of Victorian stay-at-home mothers may very well be the ones to put our society on the right road to social health, and technology can take pride in its contribution to such.

These are only examples of the social impact of technological developments. You

probably have your own favorite illustrations. All of these outcomes and others are the objects of intensive study by the social scientists, often without reference to or an adequate understanding of the technological base upon which many of these social issues rest for their origin and development. But I am more concerned today in this setting that those of us in industrial technology and technological education fill in our vistas of understanding with a more adequate study of the history of technology. This should not be an isolated and self-contained chronicle of inventions, instrumentation and techniques, but a history in which the origins of technological developments are sought and in which relationships with intellectual history and philosophy and science are emphasized. Such may not solve our problems, and it may not enable us to predict future inventions and their social impact, but as D.S.L. Cardwell of the University of Manchester Institute of Science and Technology said, "It should give us a much-needed perspective that could eventually make us wiser in our judgments and more effective in our use of technology. Conversely, it will perhaps help us to understand the difficulties and avoid some of the dangers that must inevitably lie ahead."[2]

There are three case studies I would now like to use as crude examples of the type of history I'm talking about. They involve three scientific and philosophical ideas and the ways in which we have and are converting them into practical devices and processes for doing our work. These three ideas are the material nature of the atmosphere, the interrelationships between electricity and magnetism, and the concept of mass-energy. Like the earlier selections to emphasize social impact, these are a few among many that could be used. They are favorites of mine and they are each representative of a somewhat different period in the history of technology and science.

One of the first concepts that we attempt to develop with young children in elementary science programs is the material reality of the atmosphere. It is common sense in many of our ordinary experiences to think of the "nothingness" of air. We speak of living on the earth instead of in the earth. It is not always easy to demonstrate that air occupies space and has weight. The experiences of the child are to a degree a recapitulation of the experiences of intellectual man. Having recognized the existence of air as an Aristotelian element, manifest in such phenomena as wind, it, nevertheless, took the scientific revolution of the seventeenth century to truly discover the atmosphere and to begin a search for its composition and its properties. Galileo and his pupils, Torricelli and Viviani, demonstrated that the ocean of air in which we live exerts a pressure of about 15 pounds per square inch on us and on everything around us. Pascal showed the variability of this pressure under different conditions. The realization of the existence of such a pressure in a practical demonstration is impressive even today. In the 17th century it must have been especially so. The discovery of the atmosphere led to many investigations of its physical nature and thence to investigations of properties of gases in general. Robert Boyle eventually expressed the gas laws that now bear his name and showed relationships between pressures and volumes of gases. Interest in combustion and the involvement of the atmosphere in burning was to lead to discoveries of new gases, Lavoisier's quantitative analysis of chemical reactions, and then to Dalton's expression of atomistic philosophy as theory, supported, at last, by experiment.

But back to this pressure of the atmosphere. Fifteen pounds per square inch could do a lot of work if it could be made to press against a vacuum or against a space with a reduced pressure. The mines of England needed a lot of work done. They needed water lifted out of them. Thomas Savery patented a water-pumping device in 1698 that was essentially a barrel which could be alternately evacuated and put under pressure. First the barrel was filled with steam and then condensed by pouring water over it. Atmospheric pressure, working against the resultant partial vacuum, would force water up from below and fill the barrel. Then steam from the boiler under pressure would push the water out of the barrel and to a higher elevation. Cooling the outside of the barrel with water again would condense the steam inside and the cycle would be repeated. It worked, but to lift and push water to necessary heights required pressures greater than the safe capacity of boilers of this time and the continuity of the cycle was undependable.

Thomas Newcomen's 1712 engine used the combination of atmospheric and steam pressure as did Savery's, but a number of improvements in design and in the use of materials made it a practical success. He separated the boiler and the cylinder. He used an internal spray of condensing water. He used a large working beam, not only to lift the water with a pump attached to it, but also its weight was used to operate the valve mechanism and to reposition the piston in the cylinder. Thus gravity as well as atmos-

pheric pressure was harnessed. He devised a "snifting" valve to bleed the air from the cylinder that would enter as a solute in the steam and would eventually "air log" the engine if it weren't removed.

But when we think of the steam engine we think of James Watt. Beginning in 1769 he was to make a number of modifications in the Newcomen engine which were to result in a source of power for industry and transportation around the world. He made three fundamental changes. He used a separate condensing chamber and permitted the steam cylinder to remain at high temperatures and thus improved the thermal efficiency. He developed a double-acting feature that led to a rotative engine. He accomplished this by introducing steam into the cylinder, first at one end and then the other. Third, he adapted the fly-ball governor to the steam engine. The use of Watt's engines was extended far beyond the mines as grain mills and textile factories increasingly replaced their water wheels with them. James Watt became associated with Matthew Boulton, manufacturer and financier, and the industrial revolution was on its way.

As science provided the basis for the development of the steam engine, so the engineering of the steam engine led eventually to the development of the principles of thermodynamics. Cause-and-effect designations are indeterminate as the heat engine becomes a turbine, an internal combustion device, a fan jet, and takes many other forms. Similarly, laws of thermodynamics, conservation of energy and entropy affect not only engineering but pure philosophy as well.

And all this is associated with the discovery of the atmosphere. And there's more! All of aeronautics — even space vehicular travel — has its grounding here. The airscrew, the airfoil, the flight control surfaces are engineered for operation in a fluid that has weight and occupies space. And when it's absent, as in space, very special compensations have to be made for that absence. Meteorology, with all of its instrumentation, is of course a study of this stuff, air. Mechanistic physiology got an impetus when atmospheric pressure was recognized since its importance in breathing and in respiration led to more careful analyses of such. And the end of the story is not in view. Air is real, and as a result of the recognition of such, much has happened in Western technology and will continue to happen.

My second case history deals with the relationship between electricity and magnetism. Magnetism has been long recognized, of course, in lodestones which soon were employed in compasses. Similarly, electricity, particularly as it exhibited itself in forms which we now label electrostatic phenomena, has been observed and described since ancient times. William Gilbert, in the 16th century, described magnetic phenomena in a rather comprehensive fashion and carefully pointed out differences between magnetism and electricity. In the attempts that were made to rationalize the nature of them, they fell under the spell of the movement which characterized non-material entities as subtle, invisible, imponderable fluids. Heat phenomena were also described in terms of such an imponderable fluid, caloric. Both magnetism and electricity through the 18th century, for the most part, remained curiosities for the study by the few and for side-show entertainment exploitation by the most. Benjamin Franklin was one of those who contributed significantly to theory and also to practical application of that theory in such ways as protection of buildings from the destructive effects of lightning. Condensers, in the form of Leyden jars, were utilized to provide electrical charges for a variety of experiments, including the innervation of animal tissue. In some of these experiments the recognition occurred that electricity could be generated by chemical action and the resultant, galvanic electricity, was put to new tests. Hans Christian Oersted demonstrated in 1820 that an electric current in a conductor created a circular magnetic field around the conductor.

Thus electricity and magnetism were tied together. There are certain pivotal experiments in the history of science which generate great bursts of further experimentation and research. Oersted's was one of these. One of the early responses to it was the development of a number and variety of electromagnets. Here was a way to convert the hitherto useless electricity into mechanical energy. The telegraph and the telephone were not far off and communication would be facilitated in both space and time dimensions.

However, another development of equal or even more significance was stimulated. In Albany, N.Y., a young teacher and experimenter at Albany Academy, Joseph Henry, perfected electromagnets until he was able to attract and hold loads of 3,600 pounds and more. As he carefully worked winding his electromagnets, his curiosity led him to speculate that if electricity could be used to generate magnetism, why couldn't magnetism be used to generate electricity? In 1830 he succeeded in demonstrating that moving a

coil of wire back and forth across a stationary magnet would induce an electric voltage in the wire. Michael Faraday in the laboratories of Humphrey Davy was asking the same questions as Henry. He showed that the movement of either the magnet or the coil or the contrasting movements of both would induce the voltage. He further demonstrated that the starting and stopping of a current of electricity flowing through one coil of wire would induce a voltage in an adjacent coil unconnected from the first. Winding both on a common core amplified the effect. Faraday described all of these results before the Royal Society on November 24, 1831, and his paper was published in the Annals of Philosophy in April 1832. Most of us, therefore, give credit to Faraday for the discovery of electromagnetic induction.

Oersted's experiment might have stimulated further experimentation, but Faraday's and Henry's principles of electromagnetic induction literally exploded the western world into the Age of Electricity. Electric generators, motors, and dynamos followed and were improved and applied in new ways day after day. This is still today the last basic contribution to electrical engineering as it relates modern industrial development to electricity as a source of power. Upon this, electrical engineering rests and operates. With this, Edison's light bulb and Bell's telephone would be more than toys. There have been changes in the energy source for turning the generator, but the generation of the electricity of our modern age has not changed.

Realizing that light was affected by strong electromagnets, James Clerk Maxwell showed the electromagnetic nature of light and developed in 1865 what he called A Dynamical Theory of the Electromagnetic Field. This theory provided for an electromagnetic spectrum of which visible light was only a part and postulated the possibility of generating electromagnetic waves that would be transient through space. Maxwell could not prove this postulate, but Heinrich Hertz did in 1888-1889. These Hertzian waves were put to use by a young Italian, Guglielmo Marconi, early in the 20th century, to carry information, and radio communication was on its way.

My last abbreviated case history is a twentieth-century story. Our century opened with an unquestioning confidence in two great principles of conservation — the conservation of matter and the conservation of energy. One had come from chemistry and the other from physics — specifically thermodynamics. The quest for the primary unit of structure of matter was seemingly satisfied by the elaborations of Dalton's atomic theory. As the 1890's drew closer to the new century, a number of laboratory experiences began to accumulate that were to have revolutionary effects. Roentgen produces x-rays. Becquerel recognizes radioactivity which results in transformation of atoms. J. J. Thomson, studying the electrical conduction of gases, senses there are subatomic units in the structure of matter, and the electrical nature of matter begins to be more carefully studied. Thomson, Rutherford, Bohr and others develop models of atoms, in which electrically charged units, such as electrons and protons, are the building blocks. It now began to be suspected that what had been thought to be different and distinctive, matter and energy, might be only different manifestations of the same entity. If this were so then one might be converted into the other. A shaggy-haired apostle of the new age, Albert Einstein, summed it all up in a simple-appearing mathematical expression, $E = mc^2$. Simple it might be in appearance, but complex indeed it was to be in its application and in its impact upon society.

This is what was involved when Hahn and Strassman in 1938 bombarded uranium atoms with neutrons and got a special kind of nuclear fission. This was another one of those pivotal experiments such as referred to earlier. Scientists the world over rushed to their laboratories to check the reproducibility of the Hahn and Strassman results. They were validated, and since World War II was beginning and since the military significance of these results were evident to all physicists, science went into hiding and classified its work.

Nuclear fission became a practical reality in bombs and in reactors. The technology of nuclear reactors has attracted our attention increasingly as we have faced prospects of energy shortages with other sources. Troublesome problems attend this technology. Disposal of wastes, reprocessing of fuel elements, provision of adequate supplies of fuel, and questionable safety are some of these problems. The nuclear reactor is still used as a source of heat and the energy transformation processes from the reactor on remain the same. Consequently the thermal efficiency is poor and environmental quality is threatened.

But if $E = mc^2$, nuclear fission is not the only transformation possible. The sun and

stars instead of splitting atoms use nuclear fusion for their energy. This was brought to earth in the form of a hydrogen bomb, but as a controlled and metered process, we cannot use it. As we look to the future and to probable energy problems, the advantages of nuclear fusion make it most enticing. Waste problems would become insignificant and there would be virtually no fuel-source problem as long as there's an earth of any kind. Enticing though it may be, there are monumental problems in harnessing it for metered use. The hydrogen bomb is initiated by a fission bomb. How can a fusion furnace be started? Pressure? Laser beam? There's no container for a bomb. What can contain the tremendous heat of the fusion furnace? No material will work. Magnetic field plasma are being studied as possibilities. And perhaps with the intensity of energy available there can be more efficient and more simple energy transformations than the present heat to mechanical to electrical back to heat and light and mechanical with losses all along the line.

These are my illustrative case histories to show how the fundamental ideas of science and natural philosophy may be converted into the practical applications of technology and how that application may be looped back to reinforce scientific investigation and can create profound impacts upon our society and our culture. As stated before, they are not mutually exclusive of all other possibilities and they certainly are not all-inclusive. I am, of course, rather fond of them for my purpose here and I dare suggest they represent rather fundamental ideas and fundamental developments in both science and technology. I also suggest that the technologist working with the provision of heat engines for transportation, with the provision of electric power for industrial processes, or with the provision of acceptable nuclear reactors for utility companies may be more responsible if he puts his work into the broader perspective described or alluded to in these stories.

Technology stands at the edge of history for many of us. Technology has made it impossible for me to return to the life that was lived when I was a youth. I have forgotten much of the bad of that life. I remember much of the good. I expect the advantages of an industrialized society in which I live today and I am fearful of the evils and disadvantages of such a society in the future and I so often feel impotent to influence in any way the characteristics of that future.

Daniel Boorstin, Director of the Library of Congress, in closing his book, The Americans: The Democratic Experience, had this to say:

> The pace of Research and Development...made it seem that the future of American civilization and the shape of everyday life could not fail to be determined by the mass and velocity of the enterprises already in being. This pervaded the public feelings about all sorts of industrial developments: the elaboration of packaging (from the paper bag and the folding box to cellophane to double-wrapped in cellophane to who-could-tell-what): the automobile (from Model T to the "annual" model to semiannual models to who-could-tell-what); and countless other momentums big and little.[3]

This failure of being able to influence the future he lays, in part, to the following:

> As American civilization became increasingly permeated by its technology, it lay increasingly at the mercy of the internal logic of advancing knowledge. Science and technology had a momentum of their own: each next step was commanded by its predecessor. To fail to take that next step was to waste all earlier efforts. Once the nation had embarked on the brightly illuminated path of science, it had somehow ventured into a world of mystery where the direction and the speed would be dictated by the instruments that cut the path and by the vehicles that carried man ahead. The autonomy of science, the freedom of the scientist to go where knowledge and discovery led him, spelled the unfreedom of the society to choose its way.[4]

I think Boorstin's right. I wish he weren't and it's because of that wish I want technologists to consider their work as part of a complex web of interrelations. I want leaders in technology to know our heritage as to the source of our ideas and to be concerned about the future and how our ideas will be used there. We stand at the edge of history. have a rendezvous with the destiny of future generations.

FOOTNOTES

1. Melvin Kranzberg, "Science and Technology: The Two Subcultures — and the Problem of Control. (Unpublished paper presented at the annual meeting of the American Association for the Advancement of Science, Boston, February 21, 1976.)

2. D. S. L. Cardwell, Turning Points in Western Technology. (New York: Science History Publications. 1972.) p. 224.
3. Daniel J. Boorstin, The Americans: The Democratic Experience. (New York: Random House, 1973.) pp. 597-598.
4. Ibid. p. 597.

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Graphics and Titles for Slide Series

Pete Martinez

The beginning point of all instructional slide sequences, as with an instructional delivery system, should be a highly refined listing of objectives. The objectives should act as the focal point for structuring and selecting the information presented. The objectives should define the expected competencies the viewer will possess after viewing the instruction.

The primary thrust of this paper will be the planning and execution of slides produced with a copy stand. The copy stand is used in conjunction with a camera to convert graphic information such as titles, charts and illustrations to 35 mm or 126 projection slides. There are a large number of concepts and facts which can be presented more effectively through prepared illustrations. A photograph of the interior of a wood surface planer will not provide as much information as a carefully prepared sectional drawing of the machine. Processes can be graphically portrayed for greater impact than a simple listing of the procedural steps.

One of the greatest deterrents to teaching and using copy work in a slide series is an inherent reluctance to attempt the development of the necessary graphic layout work required to produce teacher developed materials. By utilizing a variety of simple techniques and some imagination anyone can produce professional looking graphics and titles. The utilization of common objects can also help develop mood and concept formation. While almost any graphic equipment can be utilized, this presentation will be limited to material and equipment generally available to the classroom teacher or student.

While the professionals use a term "artwork" to describe any kind of work to be copied, it is not necessarily the kind of art one sees in a museum. Much of the advertising in magazines, in newspapers and on television is artwork. A graph, chart or simple title using pressure sensitive letters or a combination of these plus "found objects" can be clustered under the terms "art work." Do not be afraid of the word "artwork;" all draftsmen produce artwork in their daily work.

The preparation of the graphic layout or artwork should be based on the camera format that will be used to photocopy the graphics. The two common formats used are the

35 mm camera and the Instamatic Visual Maker. A 35 mm film has a usable film area of 24 by 36 mm. The proportional size for this film would be 2 units by 3 units or multiples of these units. The visual maker which has a 1 unit to 1 unit proportion is limited to square layouts.

The artwork, titles or graphics should be planned to fit into the proper format. If possible, the same size should be used throughout the presentation to reduce the number of camera changes during the photographic session.

If an Instamatic Visual Maker must be used for copies, preparation of artwork may be scaled to the 24 by 36 mm format, photographed with 126 film, and then be encased in slide frames intended for 35 mm film. This entails extra work but the end result is very likely worth the effort.

When developing format for the Instamatic Visual Maker, keep the 3- by 3-inch and 8- by 8-inch sizes in mind. If it is desirable to copy, say a 5- by 5-inch cartoon, the extra space around the drawing could be masked with colorful art or construction paper for a good slide in a series.

Simplicity and clarity are the keys for effective titles and graphics. Titles should be simple, direct and may use a novel approach to help set the mood. An example of mood setting through titles would be the use of cutout wood letters to identify a slide sequence on wood finishing or wood identification. The standard application of artistic principles such as form, balance, movement, etc. should be considered in the planning stages.

There are many approaches which can be used for lettering. Individuals who have received drafting instructions possess some capability in hand lettering. For those who are weak in this area, there are mechanical aids to lettering and preformed letters which require only the combining of letters into words.

LETTERING METHODS

HAND	MACHINE	COMMERCIAL	NOVELTY
Colored Chalk	Wrico	Precut Letters	Wood
Crayons	Variagraph	Vinyl Lift Off	Wire
Pen & Ink	Leroy	3-D Plastic	Alphabet Soup
Felt Tip Markers	Template	Dry Transfer (Pressure Sensitive)	String
		Paste Up	

Regardless of which lettering system is used, the technique should be practiced beforehand to insure the proper spacing and alignment. The lettering material should be tested on the surfaces of the materials they will be used on. Colored chalk and crayons respond better to a textured surface while inks and dry transfer letters require a smooth surface. Very glossy surfaces should be avoided when possible since they can cause glare during the photographic process. While the quality of work will increase with additional knowledge, serviceable instructional materials can be produced by an individual aware of the basic process.

The photocopy process requires a camera capable of focusing to a distance of about 15 inches, a lighting system and a device to hold the camera. A standard 35 mm camera can be adapted to copy work by installing a close-up lens or series of portrait rings (close-up rings). Close-up or macro lens designed for cameras with removable lenses vary in cost and quality for each brand of camera.

Close-up rings are a series of lenses which screw onto the existing lens and increase magnification. The amount of magnification is controlled by changing the combination of close-up rings used. The exchangeable lens will produce a better quality slide than the close-up rings. However, the close-up rings will perform satisfactorily for most copy work. The camera stand used for copy work may be a commercial unit or may be a home constructed unit. Commercial units are designed to provide flexibility and ease of operation. Some models of tripods can be adapted to copy work by reversing the control height shaft so the shaft and camera pad hang down between the legs. A very serviceable plywood copy stand can be constructed in the school wood laboratory. Kodak has plans for the construction of a plywood copy stand available.

The lighting system required for copy work consists of two photoflood (3200K) lamps which can be used in standard sockets with reflectors. The 3200K° refers to the color

balance of the light being produced by the bulb. The lamps should be matched to the film being used.

The film used for slide production can be any type. Different films record colors differently because they are balanced for a specific type of light. Daylight films require sunlight or light source that closely approximates daylight. Indoor flash film is designed to provide realistic colors when exposed to incandescent light which has more yellow and red components than in daylight. The information sheet packed with the film will provide information on the type of filter that is required to match the film to the light.

After the artwork is completed, the photographic process must be used to record the image. When the artwork is placed on the copy stand the camera adjustments of focusing and exposure must be made. Internal and external light meters require different techniques. When the meter in the camera is used, the exposure reading should be taken on neutral gray cards (available at photographic stores). External meters can be used to measure light falling on the artwork or to measure and average the reflected light.

After the exposure has been adjusted and the camera focused, a cable release should be used to activate the shutter. The cable release is used to minimize camera vibration which can produce fuzzy pictures. The visual maker consists of a camera and two separate copy stands with additive close-up lens combinations. The use of the unit requires mounting the camera on the proper stand and insertion of the film and flash bulb. The unit is then ready to expose the slide.

A great many ideas and photographs can be obtained by collecting pamphlets, catalogs and booklets for a specific subject area. These pictures and drawings can be cut and mounted on colored construction paper. By lettering titles or short explanations the illustration can provide excellent teaching visuals.

Charts and graphs are more effective and have a greater visual impact than statistics, tabulated data or procedural listings. Bar charts, pie charts and line graphs make comparative information more interesting and easier to comprehend. Flow charts provide a visual image that illustrates relationships much clearer than a listing of steps. Visual representation of processes are more easily graphed than a name or title identification.

A very simple and effective method of producing illustrations can be done by using art or construction paper. After the final idea has been established, an accurate sketch of the visual should be developed. The large sections of the illustration should be cut out of contrasting colors of art paper and glued in place on a neutral background. When all the major cutouts are in place, a black felt pen or india ink should be used to add detail and to outline each art-paper cutout.

When you have a single photograph or illustration which requires different titles at different positions it may be more advantageous to show each title in different locations on subsequent slides. This may be accomplished by making a series of acetate overlays with the desired lettering in each location. The acetate sheets can be placed over the picture or illustration and photocopied until the desired number of slides are completed. Diazzo overhead transparencies can be used if colored lettering is desired. It is a good idea to test the lettering system used on acetate film since some materials leave an unsightly smudge around the letters when they are placed directly on acetate.

Close-up photography of found objects in conjunction with lettering and charts can produce professional visuals. Simple cylindrical people constructed from film canisters or dowels which have been painted and have facial features added can be used in a variety of situations. The simple dolls marketed by toy manufacturers may also be used. The dolls can be used to represent almost any human interaction. One to one interactions or group functions can be illustrated by using arrows, circles and titles. Toy models and other found objects can be used to add 3-D effects and realism to a slide presentation.

When a series of steps or procedures is used in a slide series it is faster to use a strip tease procedure to photograph the sequence. Construct a single graphic to include all of the steps required. By placing a piece of art paper over all the lettering except the position to be seen on step one, you can complete one photograph. Slide the artpaper down to expose the second title and photograph one and two. Proceed until the entire list has been photographed.

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The Consortium Approach to Industrial Arts Teacher Education

John I. Matthews and Robert B. Pyle

The necessity of a degree program in Occupational Teacher Education with emphasis in Industrial Arts and Trade and Industry in the State of Delaware has been demonstrated by the action of the Council of Presidents in its selection of a director for Occupational Teacher Education. Much thought and research went into evaluation of the needs and the limitations of the state's resources for providing such a degree program. The Task Force on Occupational Teacher Education appointed by the Council of Presidents presented the initial basic plan for the degree program which has been endorsed by the council. It remains, therefore, the task of the Consortium, in conference with members of the Task Force, the College of Education at the University of Delaware, the Department of Education at Delaware State College, the various campuses of Delaware Technical and Community College, Delaware State Department of Public Instruction and other involved persons, to develop an occupational teacher education program.

RATIONALE

Because of the unique capabilities, facilities and locations of the institutions involved in Delaware, the course offerings for the Bachelor of Science Degree in Occupational Teacher Education was divided among the involved institutions. Since the primary concern at this point is for the preparation of industrial arts and the trade and industrial teachers, Delaware Technical and Community College provides most of the instruction for the technical specializations.

Both Delaware State College and the University of Delaware provide for the program content in the General Studies and Professional Studies segments of the degree. This required additional courses at each institution as the program developed. The program design called for an additional person at each institution as a teacher coordinator of Occupational Teacher Education and one additional faculty member who helps teach courses. The addition of future faculty will depend on the need generated by the FTE's involved in the program as it progresses.

PROGRAM OBJECTIVES

1. To make available the existing instructional facilities, present and anticipated curricula and faculties of Delaware Technical and Community College, Delaware State College, and the University of Delaware for the development of an integrated program of Occupational Teacher Education.
2. To gain acceptance of the proposed curriculum in Occupational Teacher Education as a Bachelor of Science in Occupational Teacher Education degree at Delaware State College and the College of Education, University of Delaware.
3. To provide a solid conceptual scientific-technological foundation for Occupational Teacher Education, both in the general studies and the technical specializations.
4. To produce a core program of studies applicable to those specifically planning to teach in industrial arts and trade and industrial education.
5. To build in sufficient instructional breadth and depth, coupled with both occupational and teaching experience, to enable the graduate to perform acceptably in either situation.
6. To provide a professional basis upon which the graduate may continue his technical and professional education at the graduate level.

THE TECHNICAL SPECIALIZATION AND SUPPORT AREAS

The key to the success of this teacher preparation program is the professional awareness that must develop. Each student is expected to spend a period of time directly involved in the industry whose skills he will be expected to teach. In addition, the occupational "practicum" is followed by a semester, or some unit of time, spent in direct observation or involvement in the classroom, Classroom Practicum, where the instruction of this material or process is being given. In this way the prospective teacher

becomes familiar, in some measure, with both sides of his profession in time to make the remainder of his professional preparation meaningful.

Each degree candidate continues with his industrial or trade experience during the remaining summer periods before graduation. In some instances cooperative programs have been developed with various industries or unions for supervised trade or industrial contact or experience. This portion of the program is readily modified for the already experienced vocationally oriented teacher education candidate. However, every attempt is made to assess the candidate's awareness of current trade and industrial practices prior to the time he begins his teaching career. This is accomplished through the NOCTI examination and initial verification of work experience.

The strength of the ongoing program in Occupational Teacher Education is its in-service and continuing education offerings. These fall into two main categories: (1) Professional education offerings applicable to certification and graduate degree, and (2) advanced or updating classes related to technical information and developments.

CURRICULAR OFFERINGS AND COLLEGE OR UNIVERSITY CREDIT

The emphasis of this preparation program is the development of adequately prepared applied science type teachers who will be the bastion of defense against built-in obsolescence in the future. The industrial arts as well as the vocational/trade and industrial education teacher of the next ten years must be a new breed of teacher if we in Delaware are to meet our obligations to the state and its citizenry. No longer can we afford the luxury of substandard preparation. The OTE program has been realistically built, often disregarding traditional ideas of what constitutes a college education, and concentrates on logical objectives and priorities.

A listing of trade and industrial teacher certification in Delaware includes 46 fields which obviously have many subfields.

- Air Conditioning and Refrigeration
- Appliance Repair
- Auto Body Repair
- Auto Mechanics
- Aviation Mechanics
- Avionics
- Barbering
- Bricklaying
- Buildings and Grounds Maintenance
- Career Orientation
- Carpentry
- Civil Engineering Aid
- Commercial Art
- Coop Vocational Education Programs
- Cosmetology
- Dental Assistant
- Dental Technicians
- Diesel Mechanics
- Diversified Occupations
- Drafting and Design
- Electronic Data Processing—Repair
- Electronic Data Processing—Operation
- Electronics Technology
- Graphic Communications
- Health Assistant
- Health Occupations
- Industrial Arts Areas—Exploratory
- Industrial Chemistry
- Industrial Electricity
- Introduction to Vocations
- Iron Workers Specialist
- Instrumentation
- Library Aide
- Machine Shop
- Masonry
- Mechanical Drawing
- Medical Service
- Mill and Cabinet
- Operating Engineer
- Pipefitter
- Plumbing and Heating
- Printing and Photography
- Radio-TV Repair
- Sheetmetal
- Stationary Engineering
- Welding

Even a cursory reading of this listing of occupations should indicate that many will not exist in their present form in very few years. Many are not to be classified as having much content of the traditional college studies. However, we are not to confuse what the worker in the field must know to be functional with what background the teacher must have to be continually operational. The teacher must be able to view the mobility of informational content in a given occupation as merely the development of a new set of applications of his basic scientific and occupational concepts.

It is essential that the teachers completing this program be able to perform in an industrial or trade setting as well as in the classroom setting. The needs of today, in this instance, are at a high level of sophistication for the eventual instructor.

Students entering this program take concurrent course work at both the Technical and Community College campus and the University or State College. This occurs over the entire 4-year period in order to properly integrate the general studies with the scientific, technically related, and occupational studies.

Some new courses have been developed at all institutions, while some courses have been utilized in their present form. The "cooperative" approach provides a means to allow credits earned in courses taught at the Technical and Community College to be counted toward the degree program where "parallel" courses do not exist at either the University or State College. The same concept of credit for course work earned through the Division of Continuing Education where special workshops, and upgrading and updating courses are offered at industrial facilities or on campus.

CREDIT BY EXAMINATION

Many candidates for the Bachelor of Science degree are from the present pool of Trade and Industrial teachers now working in the state under substandard certification. Since there are a number of "trade competency" exams developed by Educational Testing Service, institutions of higher education, and state departments of public instruction these are utilized in this program. A certain number of college credit hours applicable to the degree are granted if these exams are passed at or beyond specified norms. Alternately, candidates are allowed course credit under "credit by examination" regulations. Flexibility is also allowed for substitution of courses to fit an individual's program needs when certain course requirements may be duplication of work already done.

INSTITUTIONAL PROGRAMS AND ADMISSIONS

Both the University of Delaware and Delaware State College offer the Bachelor of Science degree with the Occupational Teacher Education option. For all practical purposes, the two degrees are set up, administered, and have structure and content in a similar fashion. Of course, because of inherent differences in available course offerings and desirable flexibility, the course requirements for all degrees are not identical.

Because the actual degree will be awarded by either the University of Delaware or Delaware State College, a student beginning his program of higher education applies for admission to the senior institution even though he may be taking most or all of his course work for one or more quarters or semesters at Delaware Technical and Community College. However, a student already admitted and matriculating at Delaware Technical and Community College may, upon the consent of the teacher coordinator at that institution, apply for admission to the degree program in Occupational Teacher Education at the University or State College. All course work taken previous to the change, that would normally be considered as part of the degree pattern, may be applied toward the degree.

VOCATIONAL TEACHER CONSIDERATIONS

A large percentage of the teachers certified to teach trade and industrial subjects in the State of Delaware are currently teaching under substandard certification. These teachers are in the process of acquiring standard certification on the basis of a 60-hour program and many wish to continue work toward the Bachelor of Science degree. Many of the courses taken toward meeting the state certification requirements have not counted toward any degree or even been classified as college credit. The course work must be evaluated by the teacher coordinator for each degree candidate, in order to determine how much credit may be granted toward the degree.

Previous work experience and occupational education is evaluated by examination as being applicable toward the degree. Competency in technical and related course work of the nature current to the present state of the art may be established by the normal "credit by examination" process. For example, a person with a significant background in electronics may be obsolete in that his total background is vacuum tube oriented. Sufficient course work to update his knowledge to current solid-state usage will be required to make him functional and thus degree credit worthy.

All teachers are expected to complete the normal general education sequence of courses, including the math and basic chemistry and physics. Unless the area of vocational education being taught can be established as not using the information, a basic materials and materials testing course will also be required. In certain instances, course work in biology or related sciences may be required in addition to the chemistry and physics requirement. Competency in each case is the major consideration.

STUDENT TEACHING AND PRACTICUM

For the degree candidate who has never taught school, the experience in occupational education may be somewhat different than expected. Each candidate must complete a period of at least seven weeks in an activity of classroom teacher aide or direct observation. This activity, referred to as a Clinical Practicum, follows a period of one semester or summer of actual on-the-job work experience performed as part of an industrial cooperative arrangement prior to the candidate's junior year.

In this way the effect of both the occupational and classroom experience gives the candidate a mental set for appreciating the professional education portion of this degree. It is essential that one understand the full significance of "methods" courses and student teaching before he gets that far in his program if they are to have meaning.

The student teaching requirement of the degree may be met by one of two approved methods. The most desirable method is the normal supervised student teaching or the supervised intern teaching experience. However, for the currently teaching vocationally certified teacher, a suitable practicum experience is also used as a student teaching substitute. The nature of this one semester, 15 weeks full-time, practicum experience is determined by the appropriateness of the circumstances in the judgment of the coordinator of the program. It may include research or development of innovative techniques and experiences new to the teacher in question, but in each case is under the supervision of the coordinator or his designee.

TEACHER CERTIFICATION IN OCCUPATIONAL EDUCATION

Industrial Arts

Completion of the approved program of studies, including the on-the-job work experience, for the Bachelor of Science degree, Occupational Teacher Education option is required for certification to teach industrial arts in the secondary schools of Delaware.

Trade and Industrial Education — The Standard Certificate

Occupational competency both in technical expertise and skills normally expected for continued employment in the specific occupational area to be taught are expected. Candidates for this certificate upon completion of the approved program for the Bachelor of Science degree, Occupational Teacher Education option, present evidence of occupational competency. This may be established by: (1) 2 years of full-time work experience in this occupation beyond the degree program, or (2) sufficient occupational experience to score above the 50th percentile rank on an Occupational Competency Exam, NOCTI.

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Technology as Content? Or, Should M.I.T. Prepare Our Teacher Educators?

Jerry Streichler

I wonder, are all teachers educators as bewildered as I am by this very broad and encompassing term "technology," by entreaties that "industrial technology" on one hand or just "technology" on the other become established as the content base of industrial arts?

Now these terms sound fine. They are respectable. Adoption and use of these terms certainly may go a long way in curing the paranoia about the second class membership that we have come to believe "industrial arts" enjoys in the educational establishment. There's only one very big thing wrong with these intriguing terms. They are most difficult to limit, to define in the sense that they can be functionally useful to the industrial arts teacher educator. By asking a series of questions which I hope will be answered by those who have been on the cutting edge of conceptualizing and functionalizing the terms, I will state what I mean to find out what they mean.

Let's pose the questions:

1. As one reviews the literature on technology, history, effects, assessment and future one finds that those involved are from history, social and behavioral sciences, engineering and the "hard" sciences. What are we saying about the role of these disciplines and fields as a new role for industrial arts is advocated?
2. If it is true that each of these disciplines and fields have developed systems of inquiry and effective methods and procedures of solving problems (technology?) do we profess to somehow teach their methods? Would we then need to possess knowledge of each of the disciplines or fields to do so?
3. What level of knowledge must one acquire in each of the disciplines and fields which can be identified within technology in order to function as a teacher educator within the systems advocated?
4. If the advocates of the new curriculums are referring to more than technology awareness, how do they propose to prepare present and future teacher educators with skills and knowledge of science, mathematics and computers vital to comprehending technology?
5. If the advocates of the new curriculums refer to technology awareness only, what will be the appearance of a bachelor's degree program designed to prepare a teacher of technology awareness?

The following more specific questions may lead to fruitful discussion and communicate my intent:

1. If one identifies the component disciplines of industrial technology as suggested for teaching on the secondary school level—management, engineering, product design, organization development and behavior, economics as applicable, etc.—in what depth and to what rigor would these be taught in the university to prospective teachers?
2. What level of mastery of these component subjects and fields should the teacher educator possess?
3. Does the industrial arts teacher educator need to possess some degree of mastery since he is responsible for selecting, organizing, sequencing and teaching of that content?
4. If either the industrial arts teacher educator or professor within the specific disciplines or fields teaches the subject matter components identified under industrial technology, it seems industrial arts teacher educators will need to possess greater knowledge of calculus, macro-micro economics, ecology, Boolean algebra, computer science, physical chemistry, etc. Is this possible?
5. To pursue the notion suggested in the preceding question, if industrial arts teacher educators are going to metamorphose into technology educators, would they not be obligated to face the raw knowledge and data that are produced by technology to be able to interpret directly from this information rather than depend upon secondary or tertiary interpretations offered by other fields and disciplines? If this is an acceptable role, how do we prepare the new industrial arts (technology) teacher educator (certainly a new renaissance man)?

These foregoing questions may have been put abstrusely. I hope that in their responses, our colleagues Drs. Lauda and Lux will provide concrete meaningful answers:

—Technology—what is it—is it really an industrial arts monopoly?

—What does the technology component of the teacher education curriculum "look like" in terms of courses, sequences, experiences?

—Who will organize and teach the curriculum?

—What sort of preparation will be required to be an effective curriculum organizer and teacher at the university level?

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Improving Graduate Education through Alternative Approaches

Lawrence S. Wright

In the 1960's, two developments in education significantly influenced the growth of alternative forms of graduate study. Bruner (1960) defended the thesis that "the foundations of any subject may be taught to anybody at any age in some form." (p. 12) This was further enlarged upon by Bloom (1968) who reported, "We are convinced that the grade of A as an index of mastery of a subject can, under appropriate conditions, be achieved by up to 95 percent of the students in a class." (p. 2)

During this period it will be recalled that there was tremendous growth in graduate education. Nontraditional students in larger numbers began seeking graduate education. Many of these had already learned and accomplished through the school of life but now wished to be recognized for these accomplishments by the award of the more formal graduate degrees. Thus change in graduate education was needed. The question of how change may be brought about within the graduate establishment is, to say the least, worthy of study.

The logical way to bring about change would seem to be through planned, systematic, continuous evaluation out of which a general responsiveness to the forces that suggest the need for change could emerge. This is how changes have been brought about in graduate education over the years.

But the rate of change is accelerating and many say that graduate education is no longer responsive to the forces of change that are bearing upon it. Alternative forms have emerged and we are wondering what to do about it. It would seem that these alternative forms have developed because the existing forms could not or would not be responsive to the forces that caused their development. Thus a parallel and competing system has developed. And we in graduate education are scurrying around trying to identify what this new thing is, wondering how we can stop its growth which is threatening our traditional system and occasionally, in a more positive vein, wondering what there is in the alternative formats that can be used to modify and to strengthen the traditional system. It is this latter concern that I discuss here: How to improve graduate education through alternative approaches.

GRADUATE EDUCATION IN OPERATIONAL PRACTICE

In practice graduate education is that set of experiences and their administrative and organizational surroundings available to students through graduate schools and colleges. This does not imply accreditation although most sets of experiences are accredited. It does not imply residency although most have a residence requirement. It does not imply degree programs although most sets of experiences were developed to be a part of degree programs.

Rogers (1969) lists 10 "implicit assumptions" related to graduate programs in psychology and suggests that we may see relationships to various graduate departments with which we are familiar:

1. The student cannot be trusted to pursue his own scientific and professional training. (p. 171)
2. Ability to pass examinations is the best criterion for student selection and for judging professional promise. (p. 173)
3. Evaluation is education; education is evaluation. (p. 134)
4. Presentation equals learning: What is presented in the lecture is what the student learns. (p. 177)
5. Knowledge is the accumulation of brick upon brick of content and information. (p. 178)
6. The truths of psychology are known. (p. 179)
7. Method is science. (p. 180)
8. Creative scientists develop from passive learners. (p. 180)
9. "Weeding out" a majority of the students is a satisfactory method of producing scientists and clinicians. (p. 182)
10. Students are best regarded as manipulable objects, not as persons. (p. 183)

If Roger's assumptions are true we have reason to be alarmed.

PANEL ON ALTERNATIVE APPROACHES TO GRADUATE EDUCATION

Growing out of the need for controlling new forces in graduate education a 16-member panel sponsored by the Council of Graduate Schools and the Graduate Record Examination Board was commissioned to make recommendations on the subject of Alternative Approaches to Graduate Education. Recommendations made by this panel were published in December 1973, so they have been available just over 2 years.

I would commend the entire report called Scholarship and Society to those who may want the rationale and detail of which it consists.

In the interest of time we will direct our attention to what the panel saw as three major issues confronting graduate education: (1) Democratization as contrasted with preservation of value, (2) Public involvement as contrasted with mastery of scholarship and (3) Diversity of graduate students and institutions as contrasted with orderliness and singularity of focus.

WHAT IMPROVEMENTS ARE SUGGESTED FOR GRADUATE EDUCATION IN INDUSTRIAL ARTS?

One has an uncomfortable sensation as this portion of the subject is addressed. The nature of the advice that has been synthesized from my experiences and study is not appropriate to every graduate school and department. Obviously I cannot speak with the authority that each of you can for your own academic environment. I shall simply suggest, "If the shoe fits, put it on" and, "Let the chips fall where they may."

I would now like to consider six areas within which attention should be given toward the end of improving graduate education. These comments are believed to be applicable to other areas of graduate study than industrial arts.

Recommendation No. 1

Graduate institutions and departments should periodically redefine their goals and objectives and make them public. The pressures for alternative approaches to graduate education are forcing institutions to reexamine their goals and purposes for graduate education. We no longer (if we ever did) have only one viable approach to graduate education, namely, producing research scholars. It would seem logical that a differentiation of purpose among institutions offering graduate work would permit both meeting the varied demands society now places upon graduate institutions and providing efficient, manageable programs within them.

Graduate programs are no different from other programs in that some statement of purpose is needed so that decisions can be related to such a purpose. Many graduate programs were developed and implemented in the 1950's and 1960's, especially within institutions that were formerly teacher education institutions. This was a period of much rapid growth and expansion. Dollars were more free than they are now or are likely to be in the foreseeable future. Overexpansion may have been a tendency. Redefinition of goals and objectives is in order.

Recommendation No. 2

Graduate institutions and departments should re-examine their policies and procedures so that they are consistent with their goals and objectives and so that they become more flexible and more responsive to both student and societal needs. Alternative approaches to graduate education are forcing us to examine the level of flexibility in our programs to meet the needs of new and nontraditional students. Traditional graduate education with all too few exceptions can only be characterized as rigid.

Traditional graduate education tends to emphasize time and space. One hardly needs to illustrate the point. Do you penalize students for failure to attend class? Do you have an institutional policy with respect to attendance? Why does an undergraduate degree require 4 years of study? Why does a master's degree require 30 semester credits of study? Why does doctoral work tend to require nominally three years of study beyond the baccalaureate degree?

The Carnegie Commission (1971) recommended that the M.D. be awarded for three years of study beyond the baccalaureate degree and that "the length of time spent in undergraduate college education can be reduced roughly by one-fourth without sacrificing educational quality." (p. 1)

Graduate Colleges are not only rigid for graduate students, but also force rigidity in undergraduate programs.

Our programs can be made more flexible and attractive to students. This can be done with no reduction in quality of programs.

Recommendation No. 3

Graduate faculties should expect to change their practices regularly to be responsive to what research evidence shows to be desirable with respect to teaching and learning.

There are two interrelated differentials between graduate and undergraduate education. The first is that in undergraduate education, the students are younger and therefore less experienced than graduate students. The second is that graduate students have, for the most part, successfully earned at least one 4-year undergraduate degree. It would seem that any other differences are designed and probably should be derived from our knowledge of what is appropriate for a graduate student population each of whom has at least one 4-year baccalaureate degree and each of whom is presumably both older and somewhat more mature than the undergraduate student.

The independence of approach, the closeness to faculty, the interaction with peers, the work at the synthesis and evaluation levels are not only appropriate to graduate education. However, they are appropriate to graduate education and to the extent that it fails to build upon these levels it is falling far short of its potential.

Graduate education would be much improved by examining our practices in teaching and learning which seem to be alternatives to the traditional and by adopting those for which positive research evidence is available.

Recommendation No. 4

Graduate faculties should re-evaluate their evaluation systems so that the focus is on learning and the output product rather than grades, credits and degrees.

The evaluation methods used control students' attitudes and activities a great deal more than many of us may realize.

Andrews (1973) discusses traditional evaluation. Although he is discussing evaluation at the undergraduate level, his comments are just as meaningful in criticizing graduate level evaluation using the traditional system:

> The epitome of quantizing the unquantizable is a grade point average calculated to 3 or 4 or even 5 "significant" figures. It would be ridiculous if it were not so serious. It fixates students on their grades instead of on their learning, it sets students into competition rather than co-operation, it fosters cheating, it restricts the nature of course goals and formats, it facilitates stereotyping of students, and the arbitrary but important distinction between one grade and another introduces an unnecessary element of anxiety into an already anxious student life. It is an absurd and socially dangerous authoritarian notion that experts know the truth and that their evaluations of people's work are absolutely valid. All the available evidence, study after study, suggests that grades are worthless in predicting success in real life, regardless of the field or career or the means of measuring success. Of course, grade point averages make the job of selecting one person out of a group, which should be difficult, easy. Grade points fit nicely into electronic computers. (p. 31)

Actually, evaluation ought to be done primarily to determine competence. It is a terrible waste of time to admit carefully selected students into graduate programs and then to weed goodly numbers out. More time might well be spent on selection and then the faculty should develop an attitude of serving students to the end of helping them to succeed. Examinations should be for diagnostic purposes and should be repeated if necessary. This in no way should be viewed as lowering standards. It should be viewed as a humane way to maintain or even raise standards. Mastery as a concept of performance is certainly an alternative with much promise for graduate education.

Our institution, on an experimental basis, has in place an alternative grading system which is designed to place the emphasis on performance levels.

The range from low to high and the definitions of developmental levels follow:

Lowest — Developmental Level 4: Can perform with supervision and assistance. Development is at the level of knowledge/awareness.

Developmentmental Level 3: Periodic assistance and/or supervision required.

Developmental Level 2: Performance without supervision, and with initiative and adaptability to related areas.

Highest — Developmental Level 1: Qualified to instruct or lead others; to combine with related competencies to develop original problems or solutions.

Recommendation No. 5

Graduate degree programs should contain a creative component which gives priority to student interests and needs as contrasted to institutional and/or professor interest and needs.

It would seem to be a mistake not to have a creative component which causes students to identify the experience, clearly delineate what it is, plan for it, collect data, analyze, organize, synthesize and report on the experience in writing. Students should be required to demonstrate entry level competencies within such a component at the master's degree level. At advanced graduate degree levels additional experiences should provide for the development of higher competency levels appropriate to older and more mature scholars. The rigidity now imposed in many graduate institutions might be softened to focus on student interests rather than institutional and faculty interests. This, it would seem, could easily be done without lowering standards.

Eckert (1974) in addressing the Midwestern Association of Graduate Schools suggested that:

> Graduate faculty members in education must become better role models if they wish to encourage habits of inquiry and discovery on student's part. (p. 18)

The role model may be our key to the teaching of the affective domain in graduate education. On the assumption that the on-campus university professor is the best role model, this augers against external degrees and no residence requirements.

Working with a professor who is in the midst of a writing project or other professional service teaches one some things about what that experience requires; for example:

1. That almost nothing is written; it is rewritten.
2. There is no short cut through the preparation, research and study required for developing a scholarly paper.
3. The only way to publish is to place priority on writing.
4. The results of publication are professionally rewarding.
5. The preparation of publications strengthen those who prepare them.
6. Research and study can be fun.
7. Those who publish gain an increased level of visibility and usually respect.
8. Advice of those who publish is sought.
9. Committee service provides for interaction with one's colleagues.

Recommendation No. 6

Graduate education whether traditional or nontraditional should maintain a high quality standard appropriate for the levels of advancement and maturity that characterize graduate students.

The fact that alternative forms of graduate education have sprung up does not in-and-of-itself mean that quality has or will suffer. The natural problem with the traditionalist is that alternative forms to the traditional are threatening. An easy way to attack is to express the fear of lowering standards. Quality is as important for alternative forms of graduate education as for traditional forms.

The Committee on Post Baccalaureate Experiences of the Michigan Council of Graduate Deans (1975) has addressed the question of quality in graduate education:

> Graduate study means advanced, intensive, purposeful study. Accordingly, in order for a learning experience to be valid and creditable as graduate education, either as an entity unto itself or as a component of a degree program it should at least display these characteristics:
>
> 1. Subject matter should be at a level which reflects and builds upon the knowledge and intellectual maturity a capable student acquires during the undergraduate years.
> 2. The experience should demand that students inquire searchingly and apply themselves fully.

3. Students should be in close and frequent contact with experienced scholar-teachers. This normally requires classes of a size that facilitates interaction between the student and the professor as well as among the students themselves.
4. The experience should be of such duration that there is time for reflection, absorption and the emergence of independence and self-confidence.
5. Resources and environment should be sufficient to promote learning and meet educational objectives.
6. Provisions should exist for evaluation of student performance to an extent that the students and their teachers can be secure in the worth of their accomplishments.

If the quality standards suggested by the Michigan Council of Graduate Deans were to be followed for both traditional and alternative graduate education, we could as easily lump the two categories together and do what is best for graduate students without worrying about whether it is an alternative form.

It is not the credits, nor the years in school, nor the amount of transfer credits, nor the degrees held that are important. What is important is how effective graduates will be in the work roles and life roles for which their graduate study has prepared them. Quality toward this end should be among our central concerns.

WHAT ARE THE CHANCES THAT GRADUATE EDUCATION WILL BE RESPONSIVE TO THESE AND OTHER RECOMMENDATIONS?

Past experiences would not suggest that we be terribly optimistic. What I predict is that alternative forms will continue to exist and will in fact flourish because traditional programs operated by traditional professors will resist change vigorously.

Hefferline (1969) has pointed out the problem:

> Traditionalists, of course, have viewed such changes in higher education as debasements—leading, over the years, to humanism, science, professionalism, utility, or—worse yet—popularization. Could the B.A. or Ph.D. degrees remain pure, unsullied, and "rigorous" if the requirements for these degrees were altered? Should job retraining be offered in the groves of academe, or be left to industry, the job corps, and parliamentary services? Should students with 'non-standard' backgrounds be allowed to enroll? Dare the universities undertake action projects on urban problems? Should the colleges risk corruption by trying to educate the masses? (p. 4-5)

Hefferline (1969) has gone on to suggest why it is so difficult for organizations to change. He lists five reasons:

1. Organizations are inherently passive. (p. 10)
2. Voluntary organizations attract members who agree with their activities. (p. 10)
3. Organizations tend toward institutionalization and ritualism. (p. 11)
4. Organizations that are livelihoods for people tend to come to exist only as livelihoods for their people. (p. 12)
5. Maintenance of institutional effectiveness or achievement (such as student's learning) is only one problem that organizations must face in order to survive. Other problems may take precedence over it. (p. 12)

Academic institutions appear to have not only the above problems but according to Hefferlin (1969) have these problems as well:

1. Their purposes and support are basically conservative. (p. 13)
2. The educational system is vertically fragmented. (p. 13)
3. Within higher education, institutional reputation is not based on innovation. (p. 14)
4. Faculty members have observed their vocation for years as students before joining it. (p. 14)
5. The ideology of the academic profession treats professors as independent professionals. (p. 15)
6. Academics are skeptical about the idea of efficiency in academic life. (p. 15)
7. Academic institutions are deliberately structured to resist precipitant change. (p. 16)

As has been pointed out, graduate education does not mean the same thing to each of us. Our institutions cannot, indeed they should not, all attempt to be research oriented institutions. Neither should we all attempt only to upgrade practitioners in the professions nor should we attempt only to be responsive to the needs of nontraditional students.

It would seem that what is needed is continued study and examination of what graduate education is, of what our institution is capable and to what graduate work can our faculty be committed. With such a study within each of our institutions we can each define what graduate education is for us, we can state this clearly and having done this, we can probably do it well. For any given institution without having first decided on and subsequently reviewing the decision about what graduate education is for that institution, graduate work is likely to drift like a ship without a rudder, never making progress toward any particular goal and certainly making it difficult for making decisions since there is no directional basis upon which decisions can be made. The task seems clear. We can not fail to define and re-define our purposes. Graduate education can be improved by selecting manageable portions of graduate education to which our institutional attention can then be directed.

What are the chances that change can be brought about in our graduate schools and colleges? It's really hard to say. But I know one thing. It depends on me and it depends on you. If we marshal our forces to meet existing and future needs, we have some chance. We really don't have much choice. It is a perpetual challenge which will exist throughout our professional life times. If we really are professionals we will rise to the challenge.

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AIACSA Special Interest Sessions American Industrial Arts College Student Association

From Heritage to Horizon by Design or Default?

Michael Sucharski

In this century technological change has become so commonplace that to present illustrations would be more boring than informative. Toffler writes in Future Shock, "Western society for the past 300 years has been caught up in a fire storm of change. This storm, far from abating, now appears to be gathering force." This storm like any great storm, buffets and tears us and the things we construct. Like a hard driven snow finds the cracks and corners, this storm spreads its grip into the entire fabric of what we are and what we know.

After Future Shock Toffler wrote The Eco-Spasm Report which examines the possibility of a mass breakdown of industrial and postindustrial society. Ehrlich expanded on the energy crunch, unemployment, and pollution as symptoms of things to come when he wrote The End of Affluence. Mass media is filled with projections and predictions for today and tomorrow. Future Alternatives for Industrial Arts, the 25th Yearbook of the American Council on Industrial Arts Teacher Education, addresses the future of industry, technology and industrial arts with thorough coverage and indepth, professional concern.

I have a daily concern for industrial arts. That concern is reflected by two professional colleagues and by the faces of 135 junior high school students. I have a concern that extends beyond my classroom and my school district with regard to the future of industrial arts. Without a play for the dramatic, my concern for some time has been accompanied by speculation about the future of industrial arts, if indeed industrial arts does have a future. It is with these concerns that I come to Crossroads '76 to share with you dialogue about our movement from heritage to horizon, its design or our default.

Not one of us is the person he was yesterday. Nor will he be tomorrow who he is today. People undergo change from day to day in a slow, almost imperceptible manner.

In this context of gradual life change I propose a model of industrial arts be couched. A living model in which change will be accepted, in fact expected. Change not in explosive or total form, but in daily evolution toward renewal, relevance and excellence.

I am well aware that proposals for a national curriculum have been made before. I am also aware of the cry from various quarters when such a proposal is made. Flexibility, individual needs, personal development, self worth, autonomy, states' rights, local control, community schools, folklore and dad's industrial arts project are all familiar variations of the cry. I have also become aware of a statement in economics by Toffler: "If it cannot be modeled it cannot be controlled." I add that then it is likely to control the practitioner.

A plan of this scope involves a multitude of particulars too numerous to detail. But some key elements can be extracted and examined to understand the model and to help ascertain whether the fantasy feasibility threshold can be approached, much less crossed.

It is envisoned that the living model of industrial arts would be composed of ongoing secondary school programs. Programs that exemplify the very best of what industrial arts is today. Programs that are propelled toward what industrial arts can become tomorrow. Programs that employ a variety of methods and strategies. Programs run by alert, articulate, creative staff. Programs that are based on conceptual content models. Programs with relevance. Programs that are vital, alive, with the zest and romance that industry gives our world. Programs that turn kids on. In short, programs that can be pointed to with pride as being industrial arts.

Secondary school programs which meet the criterion of being the forefront of the state of the art must be searched out and designated as such by industrial arts leaders. At least one model center should be located in each of the national regions of AIAA. Model centers can be used for research, visiting, future internship and residency. Centers constitute hubs from which viable industrial arts theory and, more importantly, relevant industrial arts practice can flow.

The figure that is central to the living model of industrial arts is the classroom teacher. Any discipline, industrial arts included, is not projected to the public nor is it mirrored to its practitioners by content base, scholarly works, professors or even leadership. The classoom teacher brings the discipline to display on the home ground of his community. The classroom teacher also plays a key role in the success of program growth and innovation. House, writing on the acceptance and success of innovation, discerned that it is often the teacher in innovative climate who is the informal group leader, the one who initiates, organizes and directs.

The classroom teacher is the one person in the position to monitor the impact of innovation in the classroom on a daily basis. He can ascertain if growth and innovation are rigorous enough to withstand the buffeting of the daily school routine. The teacher can judge whether the growth and innovation he is involved with are flexible enough to fit the small rural school with limited capabilities and the large metropolitan educational colossus. The teacher can adjust the level of the material of innovation and growth for students on one level to keep it palatable. Other teachers can do the same on other levels.

Though the classroom teacher is the central figure in this proposed living model of industrial arts, he is not self supporting. Support in this model must be derived from three foundations: State supervisor/coordinator, teacher training institutions and professional organizations.

The supervisor/coordinator forms the support for industrial arts in any given state. Through the distribution of funds and services the state supervisor/coordinator has the means to support a bigger and better manual training program or to lock in on the goals of technology education.

In a state where a model center would be located the chief industrial arts officer could definitely augment or detour the success of that center. But whether a state has a model center or not, the state supervisor/coordinator is in the prime position to observe, collect and disseminate information from the models to the industrial arts teachers of his state.

A second support role involving industrial arts teacher training institutions must be developed. Traditional and new methods of training and updating teachers in technological and pedagogical theory and practice must be examined, evaluated and selected. More use of internship and clinical professorship could take place in model centers with university help.

The university resources and staff must provide another important supportive service to the model centers. They must use their research and scholarly capabilities to provide input to the model center staff members. Seminars, workshops, publications and consultantships must be developed to update and vitalize the programs being used at the model centers. Questions that arise at the model centers must be submitted to the university staff and graduate schools for research and answers.

Organized personnel within the profession are the third support for the living model center. A strong, single, unified group made up of a majority of the nation's industrial arts teachers occupies a keystone position in supporting the model. A professional organization is the best possible group for spearheading the establishment, growth and dissemination of a viable industrial arts curriculum on the national scene.

Obviously a proposal of this scope calls for a unification of the profession, a gathering of the clan to bury hatchets and let bygones be bygones. Yet the majority of industrial arts teachers do not identify with any national group. If the teachers would come out from behind their circular saws and drawing boards to support relevant curriculum development, would industrial arts of the future be reoriented and revitalized sufficiently to meet the needs of students in our post industrial society?

I earn the support my family needs as a classroom teacher. But I have serious doubts about the abilities and attitudes expressed by my professional colleagues. Can they rise to the challenge set forth in the 25th ACIATE yearbook? If we were to place present industrial arts on a continuum from manual training to the newly proposed technology education, would we find our position closer to yesteryear than to tomorrow?

Most of the reasoning behind my concerns about industrial arts does not carry the tag of significant difference. Nor is it the product of complex national surveys or of sage philosophical introspection. It is mostly gut reaction that I have picked up teaching, reading professional materials and interacting in the relationships found in the classroom teachers' environment.

The school in which I teach is developing an excellent industrial arts program. The school is part of a district recognized for its leadership and excellence in educational offerings. Last year the industrial arts program was used as the junior high school model for career education in a film slated for national distribution. But industrial arts is not a key subject. It is not experiencing much growth. In fact, last year the program lost students.

Why is this so? The students take other required subjects to "get them out of the way." Parents counsel, "Take a subject that will do you some good later, not just a subject to make things." We try to inform parents that industrial arts is more than project making. But parents remember that industrial arts was where dad made things.

What about industrial arts on the state level? In an unpublished dissertation done by Sucharski at Arizona State University the image of industrial arts as perceived by industrial arts teachers was surveyed. It was concluded that:

- There was little agreement among industrial arts teachers, perceptions regarding the image of industrial arts.
- Industrial arts teachers had little agreement with regard to the present program, less agreement with regard to the philosophical foundations and almost no agreement with regard to the future directions of industrial arts.
- Industrial arts teachers placed highest priority on goals pertaining to safety, skill development and problem solving.
- Industrial arts teachers placed lowest priority on goals pertaining to the relationship of industry and society.
- The age, length of service and grade level of students had no effect on the above agreement and priorities.

The population for this study was selected Arizona industrial arts teachers. How far from national norms would the conclusions be?

With the aforementioned study conclusions available and clear, the industrial arts division of the state department of education acted. Funding requests for all workshops pertaining to innovative programs were denied for 1976. The sums involved for workshops were generally less than sums requested for equipment and teaching supply purchases.

I am a member of a committee organized by the National Center for Educational Statistics. The committee task is to design the industrial, trades and technical segment of a total subject matter taxonomy. In committee discussions I proposed that industrial arts does have unique subject matter that should be considered. The answer to my proposal came from a well educated man. His sons are enrolled in industrial arts classes. The reply was, "I don't see much knowledge of any kind contained in the building of birdhouses and stools."

Like most classroom teachers I receive input through reading and classes. I seldom see articles pertaining to industrial arts in general educational literature. A quick glance at the Educational Index shows that a large majority of all publishing is kept within I.A. publications.

Examination of the catalogs of publishers supplying industrial arts materials discloses a wide variety of books about wood, metal, drawing, etc. Publications organized in cluster format are seldom found. With a single exception the creative and innovative undertakings of the mid- and late 1960's fail to appear in usable printed form.

Writing "From the Nation" Smith notes that, "The one continuing movement that can be seen today is the clustering of like skills into programs." Smith later says, "Thirty of these [275] schools had no such type program; 43 offered some type of clustering." The schools offering clustering programs, which constitute 16 percent of the total, represent more of a shrug than a movement.

I have roamed from the horizon, the theoretical, a model. I have dredged up our

heritage." We do not have to stand at the crossroads long to realize the spread in our ranks. We as a profession stretch from heritage to horizon in practice. This spread is not a strength, but a dilemma. One that must be and will be solved.

Now I ask each of you, will we traverse the ground from heritage to horizon as a united profession by design or default?

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Major Group Special Interest Sessions, in Subject Areas

Career Education

Articulation of *A World of Choice—Careers and You* with Exploratory Industrial Arts Programs in the State of Virginia

Frank C. Owens

During the last decade, Virginia has seen significant growth in the field of industrial arts, in terms of course offerings as well as teacher and student growth. During the last five years, there has been an annual teacher growth of 6.7 percent and pupil growth of 4.25 percent, with the student population in industrial arts currently reaching approximately 95,000. Why has this growth taken place?

With the passage of the 1968 Vocational Education Act and subsequently the passage of the 1972 amendments, the door was opened for funding of certain industrial arts courses throughout the nation. The Virginia State Department of Education, Industrial Arts Service Area, outlined seven "vocational orientation and exploration" courses which could be offered to students throughout the state on a fundable basis. These seven courses were:

World of Construction	Exploring Technology
World of Manufacturing	Modern Industry and Technology
World of Transportation	American Industry
World of Communication	

These courses are to provide a portion of the exploratory courses available to a student during her or his public education. In other words, industrial arts currently provides students with at least four in-depth areas of exploration — manufacturing, construction, communications, and transportation — out of the 15 clusters of work as categorized by the career education efforts of the United States Office of Education. However, what is the real purpose of an exploratory course?

Carter V. Good, in the Dictionary of Education, defines an exploratory course as:

1. A course affording students firsthand contacts and experiences in a variety of subject fields or occupational fields
2. designed to open up new vistas and stimulate new activities in order to discover and develop interest and capacities of students
3. to contribute to their guidance in occupational selection or plans for further education.

The aforementioned courses satisfy the first two parts of Good's definition of exploratory — but in actuality, do those courses make a formal classroom attempt to provide guidance to students in occupational selection or plans for further education?

STANDARDS OF QUALITY

On July 1, 1972, The General Assembly of the State of Virginia enacted into public law the Standards of Quality and Objectives for Public Schools in Virginia — a long-term plan for improving the quality of education within the state. Of the many different areas addressed by the Standards of Quality, program standard number five was specifically addressed to vocational education and stated:

> Each school division shall provide..., training for employment by students planning to enter the world of work, or it shall develop a plan acceptable to the board of education by June thirty, nineteen hundred seventy three to provide such training.

The Division of Vocational Education, State Department of Education, in addressing this standard, developed the following continuing objectives:

> By June 30, 1975, an across the board vocational orientation program will be developed through research....
>
> By August 1977, the vocational orientation program will be evaluated and curriculum guides disseminated by the Division of Vocational Education.

However, the division determined a need to develop an unbiased orientation experience to the world of work — an experience that would orient students to all types of work, not just one particular vocational area or just vocational education. Therefore, the term vocational orientation was deleted and career orientation inserted. The purpose of such an experience would be to help the student better perceive which exploratory experiences, whether vocational or academic, would best contribute to her or his total education and eventually lead to a satisfying career.

It was decided that such an experience should be orientational in nature, a general course used to guide students in the selection of further courses of appropriate interest. This experience should give students a foundation or framework in which to plan for exploratory experiences — optimally, it would be placed in the total school curriculum before students have opportunities to select exploratory courses.

PROJECT BACKGROUND

In July 1974, funding was appropriated over a three-year period to Virginia Polytechnic Institute and State University to develop such a course. The curriculum development effort was to accomplish the following three goals, which were to coincide with the three-year effort:

1. To design a curriculum to assist students in selecting appropriate career-related educational experiences;
2. To field-test all associated instructional materials, including a teacher's implementation guide and student activity workbooks, and
3. To implement the total curriculum throughout the state of Virginia and to evaluate the effect of such a course on students.

As stipulated in the original grant, the vehicle to be used to provide an unbiased orientation to all categories of work was the 15 career clusters identified by the United States Office of Education. At the onset of the curriculum development effort — termed the Clusters Approach to Career Orientation Project — certain basic assumptions were made upon which to build the orientation course. First, it was assumed that the elementary school experience has helped the young person arrive at a self-concept, even though this concept may change in later years. Secondly, the young person who has completed the elementary school experience is capable of making tentative decisions pertaining to broad areas of career selection. And last, occupational psychologists have determined that "try-out" or "simulation" experiences and "career models" are some of the few variables in career selection which educators can utilize.

A course design was devised based on research by occupational psychologists pertaining to the types of experiences which are proven ways of helping students with career selection and incorporating the enormous amount of cognitive information associated with

the USOE 15 clusters so as to provide an optimum, unbiased career-related experience within the confines of a 50-minute class period to be taught for 180 days at the 6th or 7th grade level. The entire course should maximize a simulation/activity-based approach and minimize the cognitive, lecture-based approach.

Many occupational psychologists (e.g., Holland, Roe, Super, etc.) have developed occupational classification systems to help individuals better understand and apply information to career selection. A facsimile of John Holland's occupational classification system was chosen as a vehicle to help students apply their personal interest and abilities in a meaningful manner to the broad cognitive USOE clustering system.

COURSE DESCRIPTION

The 180-day, highly activity-oriented experience for youth was cycled to emphasize four aspects of phases of the course, to be repeated twice during 180 days.

At the beginning of the 180-day course, titled "A World of Choice: Careers and You," students are involved in a number of activities aimed at helping the individual assess both interest and abilities — that is, to focus upon the personality of the individual as it applies to work. The student must evaluate her or his individual self before being able to comprehend any occupational information. Stated in different terms, the "self" phase of "Careers and You" has as a goal to increase the understanding of self by helping students analyze personal interest, abilities, values, and needs relative to life roles.

In order for students to apply their work-related self-concept meaningfully to the some 40,000 plus occupations available at this time or the 15 USOE clusters, a framework for analyzing commonalities of occupations is needed. Holland, in his theory of occupational classification, noted that occupations can be grouped into one of six classification systems called "modes" of work. For instance, one such work mode is called realistic or mechanical, or jobs that are mechanical in nature. Such occupations as a machinist, carpenter and auto mechanic are the first to surface. However, mechanical occupations also include such professionals as a dentist (who works with dentistry tools and equipment) and a surgeon (surgical tools and equipment). The major difference between these mechanical occupations is the cognitive information bank needed to apply these mechanical skills to a specific task. Mechanical types can be found not only in the easily identifiable clusters of transportation, construction, manufacturing, and communication, but in all USOE clusters.

The same rationale can be used for the remaining five modes of work as identified by Holland. A description of each work mode is as follows:

Creative. The model type is asocial; avoids problems that are highly structured or require gross physical skills; resembles the intellectual type in being intraceptive and asocial, but differs from that type in that a need exists for individualistic expression; there is less ego strength and more frequent emotional disturbances; prefers dealing with environmental problems through self-expression in artistic media.

Conventional. The model type prefers structured verbal and numerical activities and subordinate roles; is conforming (extraceptive); avoids ambiguous situations and problems involving interpersonal relationships and physical skills; is effective at well-structured tasks; identifies with power; values material possessions and status.

Enterprising. The model type has verbal skills for selling, dominating, leading; conceives of self as a strong, practical leader; avoids well-defined language or work situations requiring long periods of intellectual effort; is extraceptive; differs from the conventional type in that preference is for ambiguous social tasks; has a greater concern with power, status, and leadership; is verbally aggressive.

Investigative. The model type is task-oriented; intraceptive, asocial; prefers to think through rather than act out problems; needs to understand; enjoys ambiguous work tasks; has unconventional values and attitudes.

Mechanical. The model type is usually physically strong, unsociable, aggressive; has good motor coordination and skill; lacks verbal and interpersonal skills; prefers concrete to abstract problems; aggressive and domineering self image; has conventional political and economic values.

Social. The model type is sociable, responsible, humanistic, religious; needs attention; has verbal and interpersonal skills; avoids intellectual problem solving, physical activity, and highly ordered activities; prefers to solve problems through feelings and interpersonal manipulations of others; is orally dependent.

After completing a series of activities that focus attention upon self, students are given opportunities to "simulate" each of the six work modes. Through different evaluation techniques, the student is able to determine which primary and secondary work modes are congruent with her or his interests, abilities, and self concept. For example, a student who had expressed interest and ability in working with her hands, working with things, might now perceive a major interest working in the mechanical mode. Likewise, a student who likes to work with people and enjoys responsibilities of leadership and direction of others might now perceive an interest in occupations that are enterprising in scope. (No occupation is purely mechanical or purely enterprising, etc. However, a specific occupation may be classified as predominantly mechanical, such as a mechanic or a dentist, or predominantly enterprising, such as a politician or salesperson.)

Research indicates that the knowledge students have about the broad range of occupations is generally limited to occupations that they encounter each day, such as the fireman, policeman, bus driver, construction worker, etc. Yet many times today's youth have a limited knowledge about what their parents actually do, much less a broad understanding of all occupations. Thus, after becoming more knowledgeable about self, and understanding and identifying with certain modes of work, the student is introduced to activities which simulate all modes of work in all 15 clusters, thus helping the student to broaden her or his aspiration level.

The cluster phase of the course is to provide opportunities for orientation to the 15 USOE occupational clusters and their relationship to the six modes of work. The third phase of the curriculum, then, answers the question where such work environments can be found throughout the USOE clusters. (Note: At this point, the USOE clustering system becomes unimportant in that a 10, 12 or 18 clustering system could be used as long as the clustering or categorizing system would include all work.)

After completing numerous activities (simulation-based rather than cognitive) representing the career clusters, students synthesize their experiences in the educational planning phase, thereby helping each individual plan for exploratory experiences, both in-school and out-of-school.

During this phase, a student identifies specific "exploratory" courses (e.g., manufacturing, construction, public speaking, etc.) that are appropriate to both the individual's personality characteristics and modes of interest (construction being mechanical in nature, public speaking being enterprising). Thus the final phase provides the student with opportunities to synthesize self, mode, and cluster interest relative to selection of in-school and out-of-school career-related experiences, and to identify the various paths available to reach a particular career (apprenticeship, college, technical school, military, etc.).

The sequence occurs twice during the year. The two cycles are similar in emphasis, but differ in the simulation experiences each provides. Also, the second cycle offers more opportunities for students to participate and observe working women and men out of class as well as out of school; to interview such persons, to participate in limited career-related experiences, and to research cluster/clusters of particular interest.

The flexibility provided by a cyclical curriculum design system will permit local school administrators to use the course as a one-semester or a one-year experience. Currently, field testing of the curriculum has been on a 180-day basis. During the 1976-77 school year, both the 90-day and 180-day experiences will be field tested and evaluated as to the effect upon the student.

ARTICULATION

"A World of Choice: Careers and You" fills a void in easing the transition from the elementary years to the exploratory opportunities youth have in the early secondary grades. However, the need seems quite obvious for this broad "across-the-board" orientation experience to be articulated with existing exploratory courses. Realizing this need, an orientation and exploration subcommittee of the Virginia Industrial Arts Curriculum Council is currently identifying methods of articulating the philosophical base of "Careers and You" with existing industrial arts exploratory courses. It is not the objective of the subcommittee to restructure the content of the exploratory offerings, but only to build upon the orientation experience; in essence, to assure that exploratory course offerings meet that part of the definition of exploratory which refers to the course contributing to the students' "guidance in occupational selection or plans for further education."

There seem to be two basic approaches or methods of articulating the orientation experience with exploration experiences without changing the subject matter content. One is an introductory or transitional unit approach. In this manner, a teacher of an exploratory course (such as WOM or WOC) would initially reemphasize the students' experience in a "World of Choice: Careers and You," helping the student transfer the idea of simulation of work modes to the new course involved. In doing so, the student would not only explore the cognitive matter of manufacturing, for instance, but also readily see if her or his chosen work mode is still appealing in a more in-depth exploration of manufacturing.

A second approach to articulating "A World of Choice: Careers and You" with exploratory industrial arts programs is through an integrated approach in which the resurfacing of work modes would take place throughout the entire exploratory experience. This approach might take the form of individual lessons to be dispersed throughout the course which would help students refocus on specific work modes after completing designated exploratory activities.

CONCLUSION

The Clusters Approach to Career Orientation Project has raised several interesting possibilities for future curriculum development and curriculum articulation. In using the philosophical base of work styles or modes, a framework or method is developed on the part of the student to relate personal characteristics to careers in general, or exploratory courses in particular. By articulating such a framework into existing exploratory courses, whether industrial arts, home economics, music, drama, etc., we can offer meaningful experiences for students and "contribute to their guidance in occupational selection or plans for further education."

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Manufacturing Education Curriculum Project

William D. Umstattd

During the past six years, two innovative junior high school industrial arts courses developed by the Industrial Arts Curriculum Project (IACP) have attained widespread adoption in schools throughout the nation and overseas. Known as "The World of Construction" and "The World of Manufacturing," these courses provide junior high school boys and girls with a comprehensive overview and an activity-centered study of the man-made world. Strong support by students, parents, teachers, school administrators, and members of the industrial community attest to their value and success.

Success of IACP nurtured an interest for further development of innovative industrial arts curriculum materials for senior high school. At this level students would study, in greater detail, many of the technologies surveyed at the junior high school. This has been accomplished through two curriculum feasibility studies which have been completed. First, the "Construction Education Curriculum Project" (CECP), was conducted at The Ohio State University during the 1973-1974 school year and reported at last year's conference. Second, the Manufacturing Education Curriculum Project (MECP), an innovative industrial arts curriculum in manufacturing for the senior high school conducted during the 1974-75 school year, is being presented at this time.

INTRODUCTION

All citizens in the United States have received an infinite number of benefits from the products created within our industrial enterprise system. Most of these products have been made to meet people's needs to improve their life-styles in an industrialized society. The machinery to maintain the standard of living functions quite efficiently, but:

...the social thinking, through which we may apply our developed capacities in humanly desirable terms, is less than adequate. (McHale, 1969, p. 12)

There is a great need for all people, especially youth, to become technically literate, regardless of whether the individual regards himself as an advocate of a humanistic or technical culture. Everyone must be aware of the improvement in our quality of life, the means by which our consumer needs are met, and many other achievements attributable to the advancement of manufacturing technology.

The nation's educational system has an obligation to provide the means by which students will develop the necessary skills, knowledge, and attitudes to cope with the man-made world. A study of manufacturing practices should help all youth make more intelligent decisions about careers, consumerism, the environment, and other societal problems created by technological advancement with which they are confronted.

One approach to solving the problems of education in the man-made world is suggested by Toffler:

> The curriculum of tomorrow must thus include not only an extremely wide range of data-oriented courses, but a strong emphasis on future-relevant behavioral skills. It must combine a variety of factual content with universal training in what might be termed "life know-how." It must find ways to do both at the same time, transmitting one in circumstances or environments that produce the other. (Toffler, 1970, p. 418)

An innovative high school industrial technology program would seem to make a viable contribution toward meeting these curriculum goals.

THE PROBLEM

Assuming that a study of "The World of Manufacturing" is an adequate introduction to manufacturing technology for eighth- or ninth-grade students, what educational experiences should be planned to provide senior high school youth with extended and more specialized knowledge of manufacturing? What should be the scope and sequence of manufacturing technology courses at the high school level which will satisfy the needs of all students? These were the questions that the research and development team needed to answer with the guidance of an advisory committee consisting of representatives of various manufacturing management and labor organizations, as well as professors from several universities involved in manufacturing education. This group met with the R&D team in the fall to make recommendations about the project. They met again in the spring to review draft copies of the feasibility study document and make suggestions for revisions.

THE PROJECT

The MECP began by establishing a set of objectives. They were to

1. outline a pattern of program elements for the high school level which extend the student's attitudes, knowledge, and skills regarding industrial technology,
2. conceptualize and create draft syllabi for those manufacturing program elements (courses) within this pattern,
3. determine effective and desirable instructional strategies and tactics for the proposed manufacturing program elements, and
4. provide a model for a full-scale research and development effort which would create, field-test, evaluate, and revise the required instructional systems in manufacturing education as well as establish plans for teacher preparation and dissemination activities.

CURRICULAR RESEARCH

A review of literature and a survey of state departments of education provided documentation of existing instructional materials. Several of the institutional projects from the 1960's and early 70's provided some input as well as courses of study, guidelines, etc., which have been developed within various states for dissemination to teachers. Some chronological analysis provided insights into trends in manufacturing technology curricula beginning with the industrial revolution, through manual training, manual arts,

industrial arts and into industrial technology. These have evolved into such programs as The Alberta Plan, Minnesota Plan, Activities of Industry, American Industry Project, Richmond Plan, Career Education in Manufacturing, and numerous others. The influences of Dewey, Richards, Bonser, Warner, Olson, DeVore, Yoho, and Maley are noteworthy.

TECHNOLOGICAL RESEARCH

The review of literature concerning trends in management, production, and personnel practices provided insights into the current and projected problems which will have a definite impact on industrial organizations and our life-styles. Some of the basic needs of the manufacturing industry related to increased productivity, increased versatility, increased precision and reduction of job monotony. (Melhope, 1975, p. 1) These are all being influenced by automation, especially as controlled by computers. Our former "buy, use, discard" life-style may very well be replaced by the attitude "buy, use, maintain, and recycle" as natural resources dwindle. A whole new field of "Secondary Industries" may emerge in the technology of recycling. As corporations become multi-national conglomerates, we will find our status as a leader in world trade being challenged by the imposition of the SI System of metric measurement. All of this will have a great impact on us as consumers, and we need to be literate on these matters.

The government is having its influence on the manufacturing industry. Legislation has been enacted or is pending to deal with many problems, from a safe and healthy work place to environmental protection and consumer considerations.

The computer may be one of the major factors in developing a post-industrial society. If not, it is certainly redesigning the labor force from blue collar to white collar personnel. In Japan a concept of Methodology of Unmanned Manufacturing (MUM) would convert a factory which has employed 700 to 800 workers in the past to one needing only a small force of about ten "control people." (Merchant, 1975, p. 2) The relative cost of labor to productivity is forcing this drastic action.

The list of topics which could be covered is endless, but there is one critical issue; the American way of life is being severely challenged to maintain its status in the world's society. We are confronted with many serious internal and external pressures dealing with the capability of our nation's manufacturing industry to sustain itself.

There are many trends to be considered as the manufacturing segments of our economic institution evolve. To summarize, some are the need to:

1. Extend the continuum of manufacturing organization from local proprietorship through national corporations, into multi-national conglomerates.
2. Pursue a commitment to protect the environment by reducing waste through recovery and remanufacturing by secondary industries.
3. Become more efficient users of current energy-producing practices and/or develop alternatives for those practices.
4. Comply with industrial and governmental regulations to make this nation a safer and healthier place to live.
5. Proceed with plans to convert to the world system of metric measurement (probably SI) to remain competitive in world trade.
6. Provide consumers with information that will extend the life-cycle of the products they purchase.
7. Develop new technologies in automation which reduce the number of jobs deemed boring by workers.
8. Design new cost-reducing tools for management to apply to production practices which improve the quality and reliability of goods produced.
9. Organize the work place to accommodate variations of work scheduling and working conditions to increase worker satisfaction.
10. Continue R&D efforts to produce better goods at lower costs.
11. Anticipate a 1.4 to 10.3 percent annual growth rate through 1980 for manufacturers of goods utilizing industrial arts related materials. (U.S. Department of Commerce, 1974)

INSTRUCTIONAL STRATEGIES RESEARCH

The question for the educator as to how to communicate this information is awesome. Is there any area — be it general education, career education, vocational education, or

whatever — that can create the necessary awareness? Hopefully, we will not continue to lag further and further behind in seeking answers.

In an effort to communicate manufacturing technology in the high school, criteria for curriculum development were studied. Based on research by various educational theorists and technologists, recommendations were made to prepare guidelines and directions in the following areas:

1. Overall guidelines for development of discipline-centered curriculum
2. Objective appropriateness guidelines
3. Psychomotor development guidelines
4. Cognitive development guidelines
5. Motivational guidelines
6. Social development guidelines
7. Characteristics of teachers (descriptions)
8. Characteristics of instructional materials (descriptions)

The strategy would be for the course developer to use these guidelines as he creates a teacher's guide, laboratory manual, textbook, instructional hardware and instructional software for each of the semester-length courses outlined.

COURSE OFFERINGS

Subject matter for the courses is based upon a rationale which provide a needs assessment, background information on technological educational systems, and current practices and projected trends for manufacturing and education. Each of the proposed courses for MECP will be outlined according to the following course titles:

1. Introduction to Manufacturing Systems
2. Metal and Non-Metal Material Processing
3. Graphic Communication Material Processing
4. Producing and Servicing Electrical/Electronic Products
5. Producing and Servicing Electro/Mechanical Products
6. Contemporary Manufacturing Problems

These courses are designed to develop an understanding of the manufacturing enterprise system. Parameters and constraints affecting the projected courses are identified as follows:

1. Products and practices of the man-made world affect the lives of everyone.
2. Life-styles of everyone have changed as a result of progress in manufacturing and construction technologies.
3. Technological advancement in manufacturing should be studied by high school age youth to assist them in making decisions about:
   3.1 Understanding the technologies of the manufacturing system.
   3.2 Becoming informed consumers of manufactured goods and services.
   3.3 Protecting the environment.
   3.4 Choosing careers.
4. A curriculum can be designed for senior high school youth as a sequel to the junior high school course, "World of Manufacturing." This prerequisite is not mandatory but should be encouraged.
5. Modern high school industrial arts facilities should be adaptable for this curriculum without extensive renovation or expenditures for equipment.
6. Instructional activities can be designed so that the concepts of manufacturing technology are presented within each course. However, a given concept receiving only a superficial comment in one course may become the focus of activities in another.

To illustrate the proposed courses, the following descriptions are provided:

Course #1. Introduction to Manufacturing Systems

The introductory course is organized so that the students participate in activities of the manufacturing industry related primarily to the R&D phase of management technology.

The focus of the course will be on those planning, organizing and controlling pre-production practices which are vital to the productivity of a manufacturing enterprise. This course is most easily adapted to the drawing and design facility.

Course #2. Metal and Non-Metal Material Processing

Following the pre-production activities, the sequence of events in the manufacturing system continues from the mock-up stage, through management approval and prototype development, and ends with finished products. The material processing course begins with management approval and provides experiences in working with metal, wood, plastic, clay and glass. By the end of the course students will have custom-produced and team-produced various components and finished products. The student should learn about preparing to produce (what materials, supplies, etc., to use) and production (separating, forming, combining).

Course #3. Graphic Communication Material Processing

Graphic communications, or graphic arts as it is called traditionally, involves relatively few processing concepts of production technology. However, it is an extremely important manufacturing industry because it provides printed products to other industries and to the individual consumer.

As in the previous course, the knowledge is pre-production and production oriented as it deals with screen processing, relief printing, continuous tone photographic processing, planographic processing, office duplicating, gravure processing and binding. Related secondary industries are also discussed.

The next two courses deal with the manufacturing systems and servicing systems. They combine the concepts of processing with post-processing. Processing includes separating, forming and combining, and post-processing entails installing, maintaining, repairing and altering. A commonality is illustrated in the following models for these two concepts. First, in the Manufacturing Systems Model, industrial materials are processed until they form the system to meet man's needs (automobiles, appliances, etc.).

The Servicing Systems Model begins with the system which needs installation, maintenance, repair or alterations and troubleshoots, repairs and tests products so they become functional again. This cycle would stop at the component level, however, because that is the smallest part which is readily available.

As far as servicing a product is concerned, the Input-Process-Output system of manufacturing is appropriate.

These three models are applied to both courses #4 and #5 to direct the learning activities.

Course #4. Producing and Servicing Electrical/Electronic Products

Through a sequence of laboratory activities, the students will learn about electrical products which produce light, heat and motion from electrical energy during the first part of the course. They will explore the electronic concepts of conducting, converting, oscillating, amplifying and switching during the remainder of the semester. (Inaba, 1970)

Course #5. Producing and Servicing Electro/Mechanical Products

This course utilizes the manufacturing and servicing systems models as they will direct the students' learning activities as they deal with electrical input-mechanical output, mechanical input-mechanical output, mechanical input-electrical output and combinations of the above systems. The sequence of laboratory activities will provide students with an opportunity to learn about electrical, mechanical, fluidic, and pneumatic products, how they operate and how to repair them. Many references will be made to the products which provide automation in the manufacturing industry.

Course #6. Contemporary Manufacturing Problems

The preceding courses have sampled the activities involved in meeting the wants and needs of people through the production of manufactured goods and the principles of servicing those goods to maintain their optimal operating efficiency. This course is designed to provide an opportunity for students to seek additional in-depth knowledge about a previous activity or to pursue new topics. It should probably not be taken before the third semester, which suggests that the student needs knowledge from the introductory and materials processing courses as a prerequisite.

A contemporary problems course should be one that guides the self-motivated student through the steps of the scientific method of problem-solving. As a result, the roles of manufacturing education instructors, and possibly of teachers from other academic disciplines in secondary education, will be that of resource personnel. Their responsibility will be to guide the students in a problem-centered approach to learning.

There are some common topics for all kinds of manufacturing systems revealed in the review of literature which should be included to varying degrees in all courses. They deal with: (1) Process planning, (2) material selecting and testing, (3) production planning, (4) tooling up for production, (5) plant layout, (6) quality assurance, (7) plant engineering, (8) manufacturing management, (9) manufacturing systems, (10) consumer satisfaction, (11) metrology and (12) automation. Problems that deal with personnel technology and the industrial organization are also common and provide career awareness, orientation, and exploration.

ORGANIZATION, MANAGEMENT AND EVALUATION

To accomplish the goals of this MECP feasibility study, a dedicated group of people with well-defined responsibilities will be needed. The plan is to have a headquarters staff and several curriculum development centers. Each center will prepare all essential instructional materials for a course or courses and forward them to the headquarters where they will be compiled in draft form for distribution to previously identified field-test centers. Following this cycle, the material will be revised and published.

Various forms of formative and summative evaluation strategies will be incorporated to maintain validity and keep the project on schedule, as well as provide data for the final report.

It is anticipated that some form of teacher education will be needed during the field-test phase and when the courses are implemented by others. This will be controlled in a manner similar to the IACP.

CONCLUSIONS

The MECP staff has examined the present state of secondary education in the United States and has reached the following conclusions about potential manufacturing curriculum proposals:

1. There exists a definite need for a discipline-centered curriculum in industrial arts at the senior high school level.
2. This curriculum should be based on a system of discrete semester-length courses.
3. These courses should reflect contemporary practices as they apply to manufacturing technology.
4. These courses should center around the following areas:
   - 4.1 Introduction to Manufacturing Systems
   - 4.2 Metal and Non-Metal Material Processing
   - 4.3 Graphic Communication Material Processing
   - 4.4 Producing and Servicing Electrical/Electronic Products
   - 4.5 Producing and Servicing Electro/Mechanical Products
   - 4.6 Contemporary Manufacturing Problems
5. The development of the specific courses should be done with adequate and diversified inputs of staff and resources. This suggests that the development take place at several institutions of higher education where educational and technical expertise is available.
6. These courses must be developed in such a manner that present senior high school industrial arts teachers can implement them after appropriate orientation.
7. A three-year developmental sequence will be needed to efficiently produce the tested and refined instructional system.

This curriculum as researched by MECP could greatly enhance the academic status of industrial arts education.

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Industrial Arts and the Career Choice Patterns of Junior High School Students

William E. West

The literature concerning occupational interests, their measurement and development, has increased in quantity and quality during the past two decades. Social and adolescent psychologists, vocational educational guidance personnel, and others have viewed the development of vocational and career decisions in terms of occupational interest. These groups have viewed occupational interests in terms of a theory of occupational development, the measurement of adolescent interests, the various relationships of interest patterns to other developmental processes, and the structuring of occupations and occupational interests in order to give a more viable order to the study of how the child grows into adult work patterns.

Occupational interests and decisions concerning occupational patterns are only one part of the study of adolescent interests. The nature of interests is complex, and to date no full explanation of them is available. The attempts to measure interests, while numerous, have been limited by the lack of a clear understanding of the multiple relationships between the various measured variables.

Adolescent interests, particularly occupational interest, can be measured. However, the use of the data resulting from the measurement of interest must be tempered by the knowledge that interests are individualized and subject to change, and can only be inferred from reported or observed behavior.

INDUSTRIAL ARTS AND OCCUPATIONAL CHOICE

Industrial arts education is only one of many factors having a bearing on the development of work-relevant behavior from which it is possible to infer occupational interests and choices. Tennyson, in discussing the current research in the field of career development, reported, "Few studies were found which dealt with the influence of school subjects, work experience, or peer pressure upon the development and expression of vocational motives." (Tennyson, 1968, p. 357) This reviewer found the literature equally void of experimentally derived information concerning industrial arts education and occupational interests or choices.

The literature concerning industrial arts courses and their function in the development of occupational interests or its influence on the occupational decision process has usually taken the form of philosophical statements or objectives. In recent years these statements or objectives have taken the form of urging new directions for industrial arts, or recognition of the role industrial arts does, or does not, play in developing occupational career patterns.

Figure 1

VOCATIONAL DEVELOPMENT
Donald Super, 1953

1. People differ in their abilities, interests, and personalities.
2. They are qualified, by virtue of these characteristics, each for a number of occupations.
3. Each of these occupations requires a characteristic pattern of abilities, interests and personality traits...
4. Vocational preferences and competencies . . . change with time and experience . . . making choice and adjustment a continuous process.
5. Series of life stages, growth, exploration, establishment, maintenance and decline . . . sub-divided into (a) the fantasy, tentative, and realistic phases of the exploratory stage, and (b) the trial and stable phase of the establishment phase.
6. The nature of the career pattern is determined by the individual's parental socioeconomic level, mental ability, and personality..., and by the opportunities to which he is exposed.
7. Development...can be guided...
8. It is a compromise...inherited aptitudes, neural and endocrine make-up, opportunity to play various roles, and evaluation of...the approval of superiors and fellows.
9. The process of compromise between individual and social factors,...self-concept and reality, is one of role playing...
10. Work satisfaction and life satisfaction depend upon the extent to which the individual finds adequate outlets for his abilities, interests, personality traits, and values....(Super, 1953, pp. 88-89)

The amount of research expressly undertaken to determine the importance of industrial arts in developing occupational interest is very limited. Anderson attempted to verify the importance of industrial arts education in providing pertinent knowledge about industry — knowledge which he assumed would be useful in making occupational decisions. (Anderson, 1967) His findings seem to support the contention that experience in industrial arts, regardless of content area, does provide for greater occupational knowledge, and that students with more experience in terms of time spent in industrial arts classes possess the greatest knowledge of industry. (Anderson, 1967) Rollings, while not dealing expressly with traditional industrial arts, also reported that exploratory experience in occupational work areas does add realism to occupational choices. (Rollings, 1967)

The importance of industrial arts courses in influencing occupational decisions has also been inferred from research on the guidance function of industrial arts completed by Jerry Olson. (Olson, 1964) However, the importance reported by Olson was the completion of questionnaire items. The review of the literature did not reveal any attempt to determine experimentally the guidance role of industrial arts.

Figure 2

VOCATIONAL DECISION-MAKING
David Hershenson, 1966

1. Each vocationally relevant decision limits the range of possible subsequent experiences for the individual.
2. As the range of experiences becomes narrower, the range of alternatives open to him becomes narrower.
3. As the range of alternatives becomes narrower, the individual becomes more focused on a given course through one or more of the following choices:
    a. positive choice
    b. adaptation to existing conditions
    c. ignoring of other possibilities
    d. inability to shift to other alternatives
4. The more focused on a given course the individual becomes, the more likely it is that he will perceive or structure future events as consistent with that course, thus reinforcing it. (Hershenson, 1966, p. 368)

The philosophical statements concerning the importance of industrial arts in making occupational decisions have arisen within and from outside the teaching profession. Betterly, reporting on a questionnaire study of the foundry industry's attitude toward industrial arts, found that foundrymen believed that "opportunity for vocational guidance" was the chief purpose of industrial arts education. (Betterly, 1963, p. 15) This view of providing vocational guidance through exploratory experiences was also amplified by Harry Broudy in Building a Philosophy of Freedom. (Broudy, 1961)

The belief that industrial arts provides important information, beneficial to developing occupational interests and useful in making occupational decisions, is well supported by the current literature of the industrial arts profession. The 1968 convention of the American Industrial Arts Association devoted considerable portions of its discussions to the importance of industrial arts in developing occupational interests. (Decker, 1968) Maley, Wilkinson, Hornig, Jackman and others made presentations to the convention concerning the occupational importance of industrial arts courses. The central theme of these presentations was that industrial arts education is more than just teaching people to work with metal or wood, or learning how to draw, or utilizing energy or electricity. The importance of industrial arts in the development of occupational interests was repeatedly brought forth by these authorities.

The industrial arts educators who wrote A Rationale and Structure for Industrial Arts Subject Matter (Towers et al., 1966) also recognized the importance of industrial arts curriculum materials in providing occupational information. One of the key assumptions concerning the project's proposed industrial arts curriculum was that, "Industrial arts is a study of industry. It is an essential part of the education of all students, in order that they may better understand their environment and make wise decisions affecting their occupational goals." (Towers et al., 1966, p. 2) The authors also stated that:

> ...all pupils...need education in basic fields of practical knowledge.... A secondary school program which provides a study of the fundamental principles of practices (praxiology) together with selected practice and a broad theoretical base may meet the challenge of the future. (Towers et al., 1966, pp. 20-21)

The importance of industrial arts in developing occupational interests and choices has not been thoroughly researched. The professional literature is replete with philosophical statements as to the importance of industrial arts courses in providing information. To date little empirical research has been completed to support these philosophical statements. However, the supposition that there is a relationship between industrial arts course experience and student interest in occupational work areas is strong enough to support research into the nature of this relationship.

The preceding statement was abstracted from a research document undertaken in 1969 which was an initial attempt by this reporter to collect information about the influence of industrial arts course content on occupational choice. The study was initiated to provide experimentally derived information about the occupational choices of eighth grade male students by a comparison of the occupational choices of three different groups of eighth grade students. The specific question to be answered was:

> Do the male eighth grade students who have experienced the Industrial Arts Curriculum Project's course of study express their occupational choices with greater clarity of occupational interests, stronger interest in those work areas related to their occupational choices, and a greater range between their highest and lowest occupational interest area scores than do the male eighth grade students who completed the eighth grade having experienced the non-IACP industrial arts course of study, or who completed the eighth grade having experienced no industrial arts during the eighth grade?

The study began in 1969, and an initial report was presented in the summer of 1969. The original study sparked an interest in deriving greater information about the occupational choices of our junior high school age youth.

The original research project was structured to include the testing of three hypotheses. The hypotheses were that there would be no differences among the occupational choices of three groups of eighth grade male students, as measured by the Ohio Vocational Interest Survey, with respect to:

a. Clarity of the interest scale related to the occupation choices.

b. Strength of interest in those work activities related to the occupational choices.
c. Range of percentile rank scores between the highest and lowest percentile rank scale scores.

D'Costa, in developing the Ohio Vocational Interest Survey (OVIS), accepted the data, people and things dimensions of work derived by the U.S. Department of Labor in preparing the Dictionary of Occupational Titles. These three dimensions were accepted as the basic elements of worker involvement in any job, and were used for structuring occupational interest groups. (D'Costa, 1969, pp. 2-3)

The 114 worker-trait groups identified in the D.O.T. were used as the next elements. These worker-trait groups were considered to be representative of the World of Work, and reasonably homogeneous and unique. D'Costa was able to plot the worker-trait groups into a three-dimensional model and derived 24 worker-trait clusters. The 24 interest-trait clusters were then used as the 24 OVIS interest scales. (D'Costa, 1968, pp. 2-4)

Figure 3

OVIS INTEREST SCALES

1. Manual Work	13. Numerical
2. Machine Work	14. Appraisal
3. Personal Services	15. Agriculture
4. Caring for People and Animals	16. Applied Technology
5. Clerical Work	17. Promotion and Communication
6. Inspection and Testing	18. Management and Supervision
7. Crafts and Precise Work	19. Artistic
8. Customer Services	20. Sales Representative
9. Nursing and Related Technical Services	21. Music
10. Skilled Personal Services	22. Entertaining and Performing Arts
11. Training	23. Teaching, Counseling, and Social Work
12. Literary	24. Medical

The cubistic model provides a structure for viewing the occupational interests of adolescents. The model isolates the different interest areas and provides some basis for explaining how an occupational interest might be formed. The individual interest areas can be described in terms of their involvement with data, with people, and with things. This involvement explains why not all the cells were used to describe the different interest groupings found in the World of Work.

ORIGINAL POPULATION AND SAMPLE

The sample was predetermined to exceed 100N, in order to give statistical significance to the findings of the study. To assure that the statistical data would represent a large enough group to give the findings validity, an original N of 212 was identified. The original N=212 was made up of Group 1, 2 and 3 with N's of 78, 67 and 67, respectively. The groups were formed from (1) all existing eighth grade industrial arts classes in one junior high school, (2) all existing eighth grade IACP classes in a second junior high school, and (3) all eighth grade boys from both junior high schools not enrolled in industrial arts or IACP during the eighth grade.

The sample was reduced from an N of 212 to a final sample of 181 due to screening factors and absences from testing situations. Three factors were used to screen sample members: Reading achievement, arithmetic achievement and intelligence test scores. Students with reading achievement grade placement below 7.0 and students with arithmetic achievement grade placement below 7.0 were deleted from the sample. Since the test content demanded a degree of understanding to complete test items, students with I.Q. scores below 80 were removed from the sample.

The data subjected to statistical analysis were derived from information relative to 3 groups of eighth grade boys. The final N for each group was

67 Group 1	Industrial Arts
60 Group 2	IACP
54 Group 3	Non-Industrial Arts

The information concerning the individual student's intelligence quotient, reading achievement scores and arithmetic scores was obtained from the student's school records. Information pertaining to the dependent variables of clarity of occupational interest, strength of occupational interest, and percentile rank was obtained through administrating the Ohio Vocational Interest Survey.

To determine the extent of homogeneity of ability and achievement among the groups in each of the selected ability factors, an analysis of variance was performed on the obtained data. The mean scores of the groups on the intelligence test and reading and arithmetic achievement tests have varying degrees of differences. The ANOV statistical treatments that indicated differences $\leq .05$ were subjected to further statistical analysis of covariance in order to determine if differences in the dependent variable means resulted from the effects of sampling error.

The ANOV of intelligence scores revealed that the mean intelligence scores of the three groups were significantly different at the .01 level. The groups were also found to be significantly different at the .05 level in reading levels. In both ANOVS's Group 1 (Industrial Arts) were higher than Groups 2 and 3, and Group 3 higher than Group 2 (IACP). Therefore, in terms of general ability and reading achievement scores, the groups could not be considered equal.

The means for the three treatment groups in terms of the dependent variable -- strength of interest in occupational work area related to the occupational choice -- revealed that Group 2 (IACP) had the highest interest score mean and Group 1 the lowest interest score mean. While this was not significant at the .05 level, it does approach significance at the .10 level.

Mean scores in clarity rating scale scores were not found to be of appreciable differences. However, the mean scores for percentile rank mean showed a difference approaching significance at the .10 level. Group 3 (non-industrial arts) had the greatest variance of scores relating to their occupational choices.

Assuming reasonable validity of the study, the results indicated that industrial arts education and IACP did not have significant influence on the occupational choices of eighth grade boys. The IACP industrial arts course did result in differences, significant at the .10 level, in the strength of interest and was as efficient, if not more efficient, in the development of clear interest and widening the range of interest scores by enhancing or detracting from unexperienced likes or dislikes. The findings also provided little support for assuming that traditional eighth grade industrial arts was more efficient than an eighth grade course of study without industrial arts in teaching about work activities. If anything, traditional industrial arts students had lower mean scores on the dependent variables than non-industrial arts students. This was true in spite of the fact that Group 1 statistically had higher intelligence scores and greater reading ability and arithmetic achievement scores.

The initial research findings relative to the role of industrial arts in occupational choices of young boys was not particularly satisfying. However, through various logical processes, the lack of positive statistical results could be minimized. The analysis of data that revealed the non-industrial arts student as possessing strong, if not stronger, interest in his chosen career area could be explained by:

1. His career choice in fact had elected him not to be in industrial arts.
2. Prior experiences in industrial arts-related activity had influenced occupational choice and, therefore, his election not to enroll in industrial arts.

The collection and analysis of the information relative to the original study did identify a workable block of young people that might be studied over a longer period of time. The eighth graders studied in 1969 were seniors in 1973. The researcher was able to identify and collect information from 86 of the original sample of 181 (42 percent) prior to the 1973 graduation from high school. In order to secure information relative to the original research problem, the identified sample was asked to respond concerning a stated occupational work area (OVIS Scales). Each $\underline{N}$ was asked to complete a survey instrument that included occupational choices in terms of 1st, 2nd, and 3rd rankings. The return of the survey instrument indicated that occupational choices made at the eighth grade, while indeed highly tentative, must be considered as indicative of occupational directions. The fact that the survey indicates 14 of 86 with matched choices after 4 years of additional maturation seemed to be very high. The frequency of the 1969 professed occupational choice still being actively considered as 1 of 3 by 54 of 86 respondents was also of note.

Figure 4

OCCUPATIONAL CHOICE
EXPRESSED BY ORIGINAL SAMPLE
1973 (N=86)

	N	Match	1 Off	2 Off	0
Group 1	26	0	6	10	10
Group 2	24	8	5	3	8
Group 3	36	6	6	10	14
	86	14	17	23	32

CLARITY OF INTEREST

		Match			1 Off			2 Off			0		
	N	H	M	L	H	M	L	H	M	L	H	M	L
Group 1	26	0	0	0	6	0	0	10	0	0	10	0	0
Group 2	24	8	0	0	4	1	0	3	0	0	3	2	0
Group 3	36	6	0	0	6	0	0	8	2	0	6	7	0
	86	14	0	0	16	1	0	21	2	0	16	9	0

STRENGTH OF INTEREST

		Match			1 Off			2 Off			0		
	N	H	M	L	H	M	L	H	M	L	H	M	L
Group 1	26	0	0	0	41	0	0	34	0	0	41	0	0
Group 2	24	42	0	0	41	42	0	34	0	0	40	35	0
Group 3	36	45	0	0	42	0	0	31	32	0	38	39	0
	86	87	0	0	124	42	0	99	32	0	119	74	0

PERCENTILE RANK (MEAN)

	N	Match	1 Off	2 Off	0
Group 1	26	0	86	68	43
Group 2	24	92	84	71	51
Group 3	36	93	84	65	47
	86	185	254	204	141

The return of the survey instrument also was tabulated in terms of clarity and interest scores and percentile rank variance reported by the 1969 testing session. The tabulation indicates that assumptions made in the initial study were indeed well founded. However, at this time, no statistical analyses have been completed.

The sample of 86 has been continued as an identified group. The spring of 1977 will mark the eighth year of the study, and the point where most of the sample will have made rather firm commitments to their career choices. The sample will be surveyed during 1977 to provide additional information concerning the influence of industrial arts subject matter on occupational choices.

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Classroom Projects

Building Jigs and Fixtures for Limited Production

Charles E. Campbell

Building jigs and fixtures with middle school students is a demanding exercise, due largely to the students' lack of experience and/or exposure to the industrial environments.

The following areas have been found to be most valuable to students in a middle school. A thorough search of the problems that are encountered in manufacturing a product is done through a careful analysis of the flow process chart that is prepared for the production of every product. The symbols used by industry should also be used in the classroom to study every operation and define the processes that require using a jig or a fixture.

Following is a concise study of the problems encountered in building jigs or fixtures:

1. Exactly what must be done? Be specific. Which of the four basic motions of materials are you trying to prevent?

circular	horizontal reciprocating
circular reciprocating	vertical reciprocating

2. Must the work be held down, prevented from sliding back and forth or just located accurately each time?
   Is a jig or fixture needed?

3. Specifically what materials will be used to construct the product?

wood	leather	ceramics
metal	cork	liquids
plastics	hardboard	textiles

4. What product processes does the particular problem involve?

material removal	fastening methods	contour changes
material separation	bonding	assembly methods
adhesive processes	fusion	finishing processes

5. What special problems should be considered?

exact location methods	special finishes	protection of finishes
special operations	special tooling	irregular surfaces
multiple openings	clamping problems	new materials
	new processes	

6. Will the materials used to construct the jig or fixture hold up under the pressures of production?

7. Will jig or fixture hold tolerances within a specified limit?

Remember to think through the most minute details and plan, plan, plan.

The drill press and router can be the backbones of special tooling. With the use of properly designed jigs and fixtures they can be used for making holes or shaping, or for design features. The bandsaw can be used for large radii and contour changes with the assistance of a jig. In general the art of building jigs or fixtures is one developed by experience and the recording of experience for future use.

Mr. Campbell is from Cleveland, Ohio.

Construction

Contemporary Construction Education and Practices

Alva H. Jared

The construction industry of today is a very dynamic, sensitive, complex and costly enterprise. Its activity affects not only the welfare of its employees and employers, but the entire economy of the United States. Conversely, it is affected by the state of the national economy.

In looking at the Gross National Product for 1974, which was nearly $1.4 trillion, the construction industry provided nearly $140 billion, or 10 percent of that figure. Nearly 71 percent of the 1974 construction market was privately owned, with residential construction providing a major portion. Due to economic changes, and interest rates in particular, residential construction has slowed in the last few years and public construction has increased.

Total 1976 construction is expected to reach $143 billion. Private residential construction will account for $53 billion, non-residential will comprise $27 billion, and public utilities and other private types will account for $19.6 billion. Thus, the total private construction will provide $103 billion. The remaining $40 billion in public construction is

accounted for by public buildings, highways, sewer and water systems, military facilities and conservation.

In a long-range prediction by the Bureau of Domestic Commerce (U.S. Department of Commerce), new construction in 1985 will approximate $340 billion, as compared to $143 billion in 1976. Private housing starts will exceed 2.2 million units, as compared to 1.6 million units in 1976. Mobile homes will be produced at twice the 1976 rate, or 600,000 units in the year 1985.

This prediction is based upon several underlying assumptions. Demographic trends, low level of new housing production during previous years, new household formations, high demolition rates and low national vacancy rates are all considered major reasons for the demand. Special attention to rehabilitation of existing units and the concern for low and moderate income family units will also increase the demand.

The construction personnel needs for the decade ahead are equally astounding. Based upon statistics from the U.S. Bureau of Census in 1972, there were approximately 3.5 million workers in construction, and with projections to 1985 it is believed that nearly 5 million persons will be needed to meet the 1985 housing goal.

The construction industry, and the homebuilding area in particular, has been one of the most inefficient and fragmented industries in the nation. Estimates indicate that there are from 80,000 to 100,000 homebuilders in the nation today. Of the nearly 50,000 full-time contractors, probably no more than 24 build more than 1,000 units per year, and only 12 companies gross more than $30 million annually.

The current trend in the industry indicates that about one in five homebuilders in the United States goes out of business each year. Thus, it is estimated by 1985 some 200 builders will account for one-third of the housing production.

TRENDS IN THE INDUSTRY

In recent years there have been great changes in the industry. Such reasons as ecological-environmental concerns, increased building costs, higher interest rates, urbanization, land values, water availability, energy crisis, solid and liquid waste disposal, transportation and population mobility are given as the causes for the recent changes in the housing industry.

In recent years the housing industry has changed to reflect the state of the construction art. Some of these changes are:

1. The organizational structure has become much larger in recent years and reflects the corporate structure of contemporary industry. Construction companies have been purchased by conglomerates or larger companies and in turn have been supplied with raw material and semi-finished goods, supplied with industrial organization, and provided special sales and marketing personnel for merchandising the construction product. Furthermore, the larger companies have also provided on-the-spot financing and provided construction guarantees on both product and workmanship.
2. New products have become available as a result of our technology. Insulation materials, new building systems, new paints and preservatives, and more plastic building materials are all examples of this new technology.
3. Housing production has become more industrialized. Pneumatic nailers, component saws, gang staplers, mechanical cores, stacking modules, factory-produced components, PERT and CPM scheduling and heavy erecting equipment are an integral part of today's construction industry.
4. The industry has become more diversified. Land utilization, environmental impact statements, community planning, local building and regulatory media, utility development, lending institutions and energy needs are all part of the contractor's daily concerns.

FOCUS OF EDUCATIONAL PROGRAMS

The construction literature over the past several years seems to indicate that there are many different ways the industry is supplying its need for unskilled, skilled and professional personnel. There seems to be little difficulty in securing unskilled labor to meet the needs of the construction industry. In fact, there are many thousands of unskilled workers now unemployed.

The skilled labor force is primarily being supplied by the apprenticeship programs associated with the construction crafts. Secondary and post-secondary programs also

provide skilled workers for the construction industry. Advisory committees from these crafts regulate the focus of the programs as well as the number and qualifications of those entering the programs.

For many years the professional in the construction industry was either an architect or a civil engineer. These professionals were prepared with a high level of proficiency in mathematics, structural analysis, reinforced concrete, architectural design, studio and estimating with the express purpose of developing designers and structural specialists. This the universities have done very well.

In recent years there has been a new professional on the construction scene—the building technologist. This college graduate has the management expertise, the finance background, the construction knowledge, the planning ability, the expediting talent, and the understanding of the various facets of the construction project to get the project designed by the architect built by the skilled tradesmen. This middle-management person is a very valuable asset on the construction team.

In a review of a recent issue of the Construction Education Directory (May 1974) prepared by the Associated General Contractors of America there were approximately 87 colleges and universities offering four-year programs in building construction. Of these, 50 were in engineering schools, 6 in architecture schools and 6 were in schools of business. The remaining 25 programs were in schools of technology or separate construction departments. The focus and orientation of these programs were varied and tended to follow the patterns and discipline of the directing department.

The report further indicated that there were 368 two-year degree schools which offered some type of associate degree program. Two-year programs in construction, design, building construction technology and concrete technology were examples. The associate degree program in civil technology seemed to be the most popular offering.

CURRICULUM CONTENT

Curricular offerings and program content must reflect the level and type of job entry as well as the state of the construction art. In all cases the content must be current and depict the prevailing trends in the industry. This will mean in many cases a marked departure from those courses and programs now being used to prepare students for this type of career.

Let us now look at some of the major content areas and basic understandings with which students must be familiar to enter the construction field. Students should be able to communicate with their peers and supervisors in both written and oral forms, should be able to use basic forms of mathematics, be literate in the basic science areas and be understanding and willing to work with people. Furthermore, students entering the construction field must be familiar with construction materials, processes and fabrication procedures.

Other areas to be included in a contemporary construction curriculum include:

1. The knowledge of financial management is paramount if a person is going to stay in business. This should include wage and salary, fringe benefits, taxation, cash flow, investments, depreciation and basic accounting principles. More contractors go out of business because they cannot manage money than because they cannot lay out a common rafter or level a footing.
2. Personnel matters are major concerns at all levels of construction. Preparing students to deal with "people problems" is most difficult, for the problems are always individualized and ever changing. Labor management roles, job identification, organization structure, union and non-union work, promotion, work stoppage, vandalism and contract negotiations are all important here.
3. As the population increases and more construction takes place, the amount of available land decreases. Thus the contractor needs to understand proper land conservation. Environmentalists, agriculturists and land developers are all focusing concern in this area. Constructors need to look to other forms of building and other systems to help reduce land confrontations. It is believed that by the year 2000, housing units of 50 to 200 floors will be common. Students need to be aware of regulatory codes and environmental impact statements, for these are a daily "fact of life" for the contractor.
4. Safety is a daily concern of the contractor as well as the dwelling occupant. The Occupational Safety and Health Act imposes daily demands on the contractor for the safety and

health of the workers on a project. This includes everything from scaffolding to noise levels. Occupant safety is equally important. Noise levels, fire protection, electrical components, sanitary systems and construction systems are being regulated by all levels of government. The students need to be aware of these regulations.

5. The obvious decline of popular fossil fuels has caused a need for alternate energy systems. An understanding of efficiency, availability, installation, operating costs, feasibility, and functional use of such systems as solar energy, geothermal, methane conversion, water and wind power should be an integral part of any current construction program. This should be coupled with ways of incorporating these systems into buildings while best utilizing the living environment. This utilization would include improved understanding of insulation types and uses, reduction of building sizes and building to effectively use the elements, not isolating man into a wasteful, artificial environment.
6. The building systems are changing. Students need to be aware of new materials, their types, processing methods, applications and fabrication procedure. Stacking modules, mechanical cores, endless lengths of man-made synthetic boards, wiring harnesses, flexible plumbing and waste systems, elimination of basements constructed of non-cement or non-clay materials, all year construction, metric conversion, changes in construction shapes, greater use of preservatives, terra construction, and material such as the "COM-PLY" stud and the "PRESS-LAM" joist will all be part of the construction scene by the end of this century. Students need to be taught to evaluate products and systems on their performance and merits. Students must also be flexible enough to change as the state of the system changes.
7. Estimating of materials and labor is the "life-blood" of the industry. In the competitive bidding arena, the estimate determines who is working and who is not working. Students need to understand quantity take-off, labor costs and the principles of quantity purchase if they are to succeed in this area.
8. Program Evaluation Review Techniques (PERT) and Critical Path Methods (CPM) are the languages used by the construction expeditor. Materials, labor and equipment must all be coordinated if the project is to be completed in the most expeditious manner.
9. As people live and interact in enclosures, waste products are developed. Thus, waste systems must be developed to accommodate used water, sewage, solid waste and contaminated air as an integral part of the dwelling. Disposing of waste in a sanitary land fill or into a stream or pond has created environmental hazards and will soon be a thing of the past. Thus internal recycling of used water, filtering, cleaning and deodorizing air and decomposing or dehydrating sewage effluent into fuel or fertilizers will be part of every dwelling of the 21st century.
10. With the high cost of construction and the high cost of obtaining money, many people will no longer be able to design and build their dream house. Thus people will be interested in remodeling existing facilities or converting facilities into multi-unit complexes. Understanding remodeling problems and costs, required maintenance, and repair in older structures, real estate transfers, advantages and limitations of condominiums, cooperative housing units, apartment complexes and multiplexes seems to be a necessity.

Collegiate construction education programs will need to be changed if the curricular offerings are going to prepare students to enter the field able to cope with the changes and requirements of the future. The writer does not expect every program to incorporate all of these facets into the curriculum, but did intend for all to become aware of the variety and scope of the problems confronting the construction industry at the turn of this century.

INSTRUCTIONAL METHODOLOGY

Instructional methodology will also need to take a somewhat different orientation if it is to reflect the current practices in the industry. Students need to be exposed to off-site fabrication practices, on-site erection procedures, mass production equipment, building components, building economics, employee-employer relations, job costs and estimating, scheduling and live construction activities.

Furthermore, the construction activities need to be oriented toward a "group activity-total involvement approach" rather than the "single student project-process orientation" which has been used extensively in the past. These activities should ideally incorporate life-size and purposeful construction activities designed, planned, estimated and constructed by the students. Concession stands, baseball dugouts, garages, utility

sheds, press boxes, vacation cottages, client remodeling projects and even houses are examples of meaningful educational construction activities which can be completed as part of most construction classes. Internships and cooperative work experiences also provide opportunities for students to receive valuable, meaningful experiences.

Activities such as field trips to building sites and industrialized housing plants, the use of slides and films of current construction practices and the utilization of construction personnel as resource persons provide valuable instructional experiences for the students. These are hardly substitutes for the actual experiences and should be considered second best.

Finally, the construction industry is a major part of the American economy; there are programs available to provide educated persons to fill the needs of the industry. The industry is changing continuously, demanding continual change in the construction education programs.

Construction education must provide the basic skills and principles required for career entry, be sensitive to and familiar with the demands of society and changes in the industry, and provide experiences that reflect current construction thought and practices. These are all necessary if the educational programs are to perform the basic functions they claim to be performing.

Let us prepare our students to enter the construction field of today, not the industry of the 1920's. The decision is up to you. Let us all accept this challenge.

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Students Design and Build Home at School Forest for Continued Expansion of Outdoor Education Program

Allen Johnson, Robert Zuleger and Kevin Johnson

INTRODUCTION TO WAUSAU, WIS., AREA

The population is about 40,000. It is located in center of the state between Green Bay and Minneapolis, Minn. Marathon County is an industrial, manufacturing and farming area. Employers Insurance, Drott Manufacturing and Wausau Homes are examples of industry.

Wausau School District has about 11,000 students, 2 high schools, 2 middle schools, 13 elementary schools, 1 Catholic high school and other parochial elementary schools. West High School, grades 9-12, was built in 1970 and has an enrollment of about 1,950 students. It is on a flex mod schedule, and the Industrial Education Department has a staff of 6-1/2 teachers. There are about 1,050 students enrolled in industrial education at West. Beginning, intermediate and capstone courses are offered in all areas.

THE SCHOOL FOREST AS AN OUTDOOR EDUCATIONAL CENTER

The School Forest is about 12 miles from West High School. It consists of 320 acres located on Wisconsin River. Approximately 9,000 students visit the School Forest each year on programs ranging from 1-day field trips to 1-week outdoor education experiences. (Example: All sixth grade students spend 1 week at the School Forest, and all 5th graders spend at least 3 days of overnight camping.)

Facilities consist of cabins, classroom and crafts building, two garages, outdoor shelter/classroom, office, museum, boys' and girls' shower/lavatories, dining hall/kitchen, another shower/lavatory complex and a two-bedroom home. All structures are student designed and constructed except Bannerman Hall. This kitchen/dining facility was designed by students, but built by a contractor for $115,000. With two exceptions, all 19 buildings were built by senior Capstone classes since 1960. The outdoor education pro-

gram definitely is a boon to a good building trades program which has limited financial assistance from the school district for buildings.

INTRODUCTION TO BUILDING A HOME

There was a need for supervision of School Forest facility and care of forest; fire and vandalism were the main factors. The School Forest Board of Directors (Outdoor Education Committee) submitted a request to the Board of Education budget 2 years previously.

We heard the Kiwanis Club was looking for a large project and had about $9,000 to spend. They could buy a panelized constructed Weston Home and have it delivered, with the Board of Education donating $5,000 for basement, water, etc., and have it all done. Mr. Zuleger and I met with the Board of Education and the Kiwanis Board of Directors and pointed out that all the other buildings had some or total involvement by students. Maybe we should continue that trend. We agreed, with student approval, to build a student-designed caretaker's home for $20,000. The Kiwanis Club agreed to pay $9,000, with the School Board to put up the additional $11,000 and the lot. That was January 1975.

HOME BUILDING PROJECT

Instructor's Concept of Project

After some discussion and apprehension, Al and I decided to undertake the building of the house as a student project. We decided we would take three semesters to do this: One semester for design, estimating, etc., and one year for actual construction. We also felt that the same students who designed the building should have to use their own plans to build it. For the actual building, we combined the Vocational Building Construction and Drafting classes. This gives the drafting students a better background in construction. We have scheduled these classes at the same time in the past.

By combining the courses, you gain the advantages of two instructors; you have much more flexibility on time to work on the project. They also can check on each other; what one forgets, the other may remember. With two instructors on the job site, you can better keep on top of things. The student doesn't have to wait as long if he needs help. We also wanted to work on some type of publicity for the students. We decided to take slides and prints as we went along to be used some way.

Woods and Drafting Course Structure

The woods program at West is made up of four courses. Woods I is a general introduction. There are two courses of Woods II: Bent Woods Lamination first semester and Beginning Building Construction second semester. Woods III is a Vocational Capstone program.

The drafting program is made up of three levels, Drafting I and II being primarily introductory, and Drafting III is a Vocational Capstone program, with the student selecting to major in either mechanical or residential drawing.

After having met with the Kiwanis Club in December, we proposed to the Beginning Building Construction students, in January, the idea of designing a house second semester and building it the next school year. They decided that they were willing to tackle the project. The class was made up of sophomores and juniors.

Design Stage

The Board of Education had decided that it would be a two-bedroom home, probably for an elderly couple. With only this to go on, the students started sketching floor plans and elevations. One of the first things we did was to take the students to the School Forest and spend a half a day there.

About half of the students had never been there. They looked at a tentative site and spent the rest of the day discussing some of the problems and advantages of the site. They also took some rough measurements. After having visited the site, the students' ideas began to shift. They started looking at the possibility of a walkout basement and patio or deck. Within a couple of weeks they decided on a final floor plan.

After some tentative plans were drawn, they were presented to the Kiwanis. They liked the plans, and the students continued drawing the rest of the plans. During the

semester the students went on two field trips. They toured Crestline Window Corporation, who eventually donated the windows for the house. The other field trip was to Wausau Homes' model home village.

After the plans were completed, the students made a complete materials list. From this materials list they started work on estimating. They usually got two or three prices from different firms in town.

While they were working on plans, estimates, materials lists, some of the members of the class were trying to secure the necessary permits. Some of the students soon found out what "getting the run-around" meant. They also had a soil testing unit come and explain how a perk test is done and do the necessary perk test.

One afternoon was spent clearing the site of trees. Some tentative stakes were placed where the house was to be located. Site clearance was done in the spring so the construction could begin immediately in the fall. During the semester, Al and I requested that our classes be scheduled at the same time next year. We also set up our schedule so that the only class we had on Wednesday was our combined class. We are on flex mod scheduling, so this was possible.

We tried to work out the students' schedules so that they only had our class on Wednesday. A couple of students had some conflicts and stayed back every other week to attend their class.

This School Year

School Forest is about 12 miles from the school. On Wednesday the students report to school as usual and go directly to the wood shop. After homeroom, the class boards a bus provided by the school district. Most of the time we carry tools and supplies on the bus. After the first couple of weeks we realized that if we had another vehicle, we could stay after the bus had returned in the afternoon. From then on we stayed after with anywhere from 3 to 6 students. These students either had their own car back at school or we dropped them off on the way back to school. This staying longer really helped the project. It gave the other students a chance to work right up to 2:15 without cleaning up. It also gave the students a chance to tie a lot of ends together before leaving. We usually stayed for an extra hour to two hours.

Along with going out every Wednesday, one of us occasionally went out for half days with 3-4 students. We did this a couple of times in the beginning to get going, and later went out again to do some forming for concrete and lay underlayment. A couple of times Al went out on Tuesday all day with approximately half of the class. The whole class went on Wednesday again, and then I followed with the other half of the class on Thursday.

During Christmas we tried a different approach. We asked for volunteers to work two days with pay. We got 13 volunteers. The students were paid a minimum wage. The instructor was paid a wage equal to his daily pay. The combined class also met twice a week for 40 minutes. This time was usually spent discussing and solving problems that need to be solved before Wednesday. Usually on Monday the student foreman made job assignments. Each student knew ahead of time what he was responsible for that day. Some of the jobs had to be planned a couple of weeks in advance to make sure materials were there. A list of special tools needed was also made.

During open lab time, the building construction students were expected to order all their materials. In the fall they painted the windows and garage door, back at school. During third and fourth quarter they worked on making wainscoting and the kitchen cabinets. All the trusses were made in the basement of the school and hauled out to the site. As all this was going on, a couple of students were working on publicity for the project.

GRAPHICS

Background

The Graphic Arts Department at Wausau West has three course levels, as do the other areas of industrial education. Our graphics facility is designed for both industrial education and pre-vocational education. We have both letterpress and offset, with the major emphasis placed on photo offset lithography. r facility includes approximately $100,000 of equipment.

Production

The Capstone level deals primarily with production work, although individual projects

for special student needs are also used. We handle about 50 production jobs each year, ranging from small ticket jobs to large posters to 50-page books.

Student Publications

We produce all of the student publications except the yearbook. Our school newspaper is a 16-page monthly, with a 4-page paper every two weeks. Other student publications include yearly athletic booklets and literary books.

All phases of all publications are produced entirely by students with the equipment available to them at West High School.

Involvement in School Forest Project

The graphics area got involved with the School Forest home project for several reasons. First, there was a need to keep people informed. The staff felt we should be communicating with our own school, the school district, the community and people within our profession. Secondly, the team saw some excellent opportunities for students to gain real learning experiences by being involved with both the construction and the communications aspect of the project. It was also an opportunity for the instructors to work closely together.

Plans

Planning is the key to any successful job. We asked two students, a junior boy and a senior girl, to take on the project. It was decided to print four separate jobs. Phase one, two and three would be smaller brochures telling the story of planning, roughing in and finishing, respectively. The fourth job would be a larger booklet telling the entire story.

In addition to the four publications about the house, the students also planned and printed a two-page center spread in the school newspaper and reproduced a booklet used to tell about the School Forest.

The Job

The job entailed four steps. The two graphics students were responsible for all of the photographing at the building sight. Both black and white prints and color slides were taken.

Secondly, the students had to lay out the jobs in advance, planning which photos would be necessary. The next step was to select from their photos and write the stories. Finally each publication was to be printed on schedule.

Conclusion

It would be untruthful to say all went well. There were a lot of problems that affected the final outcomes. Phase one was printed last spring. Phase two was printed three weeks late, and Phase three never even happened. The final booklet was printed with a few minutes to spare.

One possible reason for the problems may be the students that were chosen. It was a bigger commitment than they realized. Much more supervision is necessary than was originally planned, and more planning time should have been spent.

GENERAL COMMENTS AND PROBLEMS

We tried to incorporate as many different types of problems and materials into the house as possible. This would give the students a wide range of experience. We also had hoped to involve other departments in the school. Our original intent was to have home economics girls help with interior decorating. We wanted to involve the Art Department with doing some of the art work for the various publications. We didn't do either of these. Once we got rolling, we were so busy and wrapped up in our own problems that we never had time to coordinate things with them.

One of our first mistakes was not checking the slope of the lot in the spring time. Our original plan had a patio behind the garage. In the fall, when we started checking the slope and found out it was steeper than anticipated, we changed to a deck rather than a patio. This called for some immediate plan changes.

During the fall the director of the School Forest had the boundary lines checked. We soon found out that the perk test holes we had dug last spring were not on the School Forest property. Luckily, the house was on the property; we were almost done with the foundation at the time.

You soon find out that you have to make decisions on the spot, without hesitating. For example, on Wednesday, if the weather doesn't cooperate, you have to change job assignments, or materials may not come on time.

A problem that we soon discovered was that the plan was poor and incomplete. This may have been the result of several factors. Many of the students who drew the plans were sophomores and the rest juniors. Another factor was that the students using the plan were all inexperienced, and again many of them juniors. A third aspect was that maybe we as teachers didn't check and push the students hard enough when they were designing the house.

An asset to the project was the fact that the School Forest has a Green Thumb Project. During the week when we weren't there, they often cleaned up for us, did minor back filling and some staining of siding.

PUBLIC RELATIONS

Some inportant points were student-teacher interest throughout school, school newspaper, class discussion, just the fa that they are seen with lunch every Wednesday A.M., and dressed in working clothes with boots and hard hats.

Community Knowledge of Project

1. T.V. coverage, Kiwanis meetings and donation of building site, different student representatives attended all informational meetings with Kiwanis.
2. Daily Herald articles help keep the public informed.
3. Parents were kept up to date from the beginning. They were invited to the home construction site for supper one year later. This included a slide presentation by students and a tour of the house.
4. Visitors from business, education and industry.
5. Dedication (future). Sometime in May.
6. Phase one and two productions, and finally a large booklet for distribution to all students, administration, Board of Education, Kiwanis, parents, and AIAA members, as a final show of personal commitment and accomplishment by a group of 25 high school juniors and seniors.

FUTURE OF SCHOOL FOREST AND ARCHITECTURAL DRAFTING/BUILDING TRADES PROJECTS

1. A building to house the teachers who have to stay out there when their 5th and 6th graders are there: Cottage type — maybe combination log, frame and stone — 1976-77.
2. Build a greenhouse at West High School grounds for Science and Agriculture — 1976-77.
3. Observatory (designed but not built as yet!)
4. Possibility of a new museum-type building. Date - 19?

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Construction Technology in the Tradition of the Activity-Based Concept

G. Eugene Martin and Richard L. Resurreccion

Construction technology, until recent years, has been neglected as a program of study in industrial arts. Some notable early attempts to include construction in industrial arts were made by Fredrick Gordon Bonser at Teacher's College in the 1920's and William Warner in the "Curriculum to Reflect Technology" in 1948. Unfortunately, the profession had failed to expand sufficiently the efforts of these researchers. However, some recent curriculum thrusts have brought about a resurgence of interest.

Industrial arts, by definition, is the study of industry and technology, and the problems and benefits of living in an industrial and technological society. It seems reasonable to conclude that if construction is the largest industry in the United States, then it should be an integral part of the industrial arts program. Furthermore, several governmental and industrial studies have shown the need and described the extensive role construction will play in the redevelopment of man's built environment. These considerations have begun to reach the threshold of awareness in our profession.

The paramount question becomes: How should construction be taught in industrial arts? This presentation will not deal with all the issues related to this question; rather, we will focus on construction technology education as a developmental experience for children.

The activity-based concept lies at the heart of the humanistic school of thought in industrial arts. Although the activity-based concept did not find its birth in industrial arts, the approach has been fostered in many sectors of the profession. This point can be traced historically in the writings of such people as John Dewey, Edward Thorndike, Fredrick Gordon Bonser, William Warner and in several recent curriculum thrusts.

Child development at a proper rate and normal sequence is essential for a successful and fruitful life in a complex society so heavily influenced by industry and technology. During the era of industrialism, several educators began to encourage the study of the constant interplay between the organism and the environment and the problems of personality development in a life-long sequence of tasks. The study of industrial occupations emerged as a realistic method for encouraging favorable circumstances for children to become full participants in society. John Dewey stated:

> Occupation as thus conceived must, therefore, be carefully distinguished from work which educates primarily for a trade. It differs because its end is in itself; in the growth that comes from continual interplay of ideas and their embodiment in action, not in external utility. (Dewey, 1900, p. 82)

He later commented:

> Manual training, shopwork, ...engages the full spontaneous interests and attention of the children. It keeps them alert and active, instead of passive and receptive; it makes them more useful, more capable, and hence more inclined to be helpful at home; it prepares them to some extent for the practical duties of later life.... (Dewey, 1907, pp. 26-27)

The concept of occupations established a theoretical basis for socialization.

Fredrick Gordon Bonser implemented Dewey's ideas through an industrial arts activity-based program. (Luetkemeyer and McPherson, 1975, pp. 261-62) Bonser drew on activities growing out of man's fundamental needs — food, clothing, and shelter. In so doing he brought together the intellectual and practical phases of education.

Activity-type learning remains valid in today's schools. Walter Waetjen, in describing contemporary activity learning, referred to this method as a means of developing a sense of the present. (Waetjen, 1975) Over the years technology has drawn the student further and further away from a knowledge of the technologies which makes possible the abundant goods and services. An activity program bridges this ever-increasing gap by increasing student awareness through real involvement with tools, materials, processes and occupations.

A child learns through life, and activity-based programs contribute to a more efficient way of realistically putting it all together. The following poem, entitled "A Child Goes Forth," describes well the magnitude of essential learning experiences. (Creative Play Things, 1965, p. 1)

A CHILD GOES FORTH

A world of sights to focus on:
Color, shadows and motion;
A miniature world; a telescopic world

A world of sounds and rhythms;
Tones, chords and beats;
Music to make and appreciate.

A mechanical world to discover:
New things to handle, smell and taste;
Mastering all the tools of work.

A world of living things to relate to:
Life processes to comprehend;
Physical laws to discover.

A world of aesthetics to assimilate:
Points, lines and shapes to experiment with;
Space, textures and patterns to link together.

A quantitative world of numbers to master:
Experiences with time, weights and measures;
Patterns of sequence, magnitude and multitude.

A world of language to acquire:
Visual imagery and phonics;
Words and sentences to practice.

A physical body to control:
To run, jump, climb and balance;
To learn habits of personal hygiene.

A social world to relate to:
To give and take; to associate with one's peers;
To develop discipline and practice self-control.

The community and the whole world to explore:
Physical features, climate and weather;
The interdependence of all the people who inhabit it.

Help every child go forth with confidence and vitality.
Help all children attain their potentials

Let us turn now to the nature of the post-industrial society. This nation has evolved from a relatively simple agrarian society dominated by home production to an age made rich by scientific revolutions. It is a nation no longer in the shadow of World War II, as some might still believe. Sociologist Daniel Bell wrote:

> The post-industrial society is a society in which business is no longer the predominant element, but one in which the intellectual is predominant. The majority of society will not, of course, be intellectual, but the sense of the society, its spirit, the areas of conflict, of advance, of engagement, will be largely in intellectual pursuits. The major institutions of society will be a vast new array of conglomerations of universities, research institutes, research corporations. (1964, p. 44)

The 1964 statement by Bell has become increasingly more evident each year since its publication, and the future looks even more dramatic.

Recent publications in our field have pointed a clearer direction for developing people who can initiate and respond on a conscious level to the multiplicity of interactions and the multiplicity of experiences. The possible disjunction between technology and culture need not occur if we develop an educational delivery system through industrial arts.

Concern over this expanding "intellectual technology" has led several industrial arts educators to advance new curricular approaches. Perhaps the most common scheme has been the family of related technologies theme. Under this approach, industrial technology is examined in clusters based on certain commonalities.

Most programs have emphasized three general cluster categories: power and energy, production or manufacturing, and graphic communication. This is an example of significant departures from the traditional areas of concentration which might include wood, metals, plastic, graphic arts, drafting, and automotive mechanics. The rationale for this traditional type of curriculum design was valid when the technologies, materials, and occupations were integrally linked. Today and in the near future, technological commonality rather than material or occupational activity will serve as the basis of curriculum design. (Starkweather, 1975)

How does construction technology fit into schemes such as the family of related technologies approach? First, let us briefly examine construction as an activity of our society, and then turn to its place in our programs.

Construction has always been inextricably linked to the essential needs of man. A brief examination of a primitive communal setting makes this point vividly evident. Huts, a road, a bridge, and a dock are just a few of the constructions early man was forced to build. These constructions are not too much unlike the settings of our early settlers, and certainly they remain the same on a larger and more sophisticated scale.

Construction will remain extremely important in the future of the United States. The late President Lyndon Baines Johnson clearly defined the role of construction technology in the future when he said:

> In the next 40 years, we must completely renew our cities. The alternative is disaster. Gaping needs must be met in health, in education, in job opportunities, in housing. And not a single one of these needs can be fully met until we rebuild our mass transportation systems. (U.S. Department of Housing and Urban Development, 1968, p. v)

The United States Congress has likewise stressed the need for construction in the Urban Growth and New Community Development Act of 1970:

> It is the policy of the congress and the purpose of this title to provide for the development of a national urban growth policy and to encourage the rational, orderly, efficient, and economic growth, development, and redevelopment of our states, metropolitan areas, cities, counties, towns, and communities in predominantly rural areas which demonstrate a special potential for accelerated growth; to encourage the prudent use and conservation of our natural resources; and to encourage and support development which will assure our communities of adequate tax bases, community services, job opportunities, and well-balanced neighborhoods in socially, economically, and physically attractive living environments. (p. 11999)

A. J. Teller has developed an analysis of the city through various life cycles. He views the process in four stages: birth, decay, revival, and rebirth. The revival stage obviously necessitates construction modulated by a humane planning process. (Teller, 1970)

Construction activity is broad and reaches into several economic and social institutions. (Resurreccion, 1970, pp. 45-53) Roy Mason identified several institutional influences in his Futurist article, "Architecture Beyond 2000." (1975) Some developments for satisfying man's basic needs and expressing his highest aspirations will result in new materials, structural concepts, energy sources, transportation networks and much more.

The preceding gives rise to the issue of construction technology in industrial arts. The close relationship between industrial arts and trade and industrial education has led some to think of construction mistakenly in terms of skilled and semi-skilled occupations. In the post-industrial society, intellectual decisions at the professional level will determine the nature and direction of construction technology. Our students should understand the decision-making process if they are to have a say in the future constructions which will affect their lives. After all, the Jeffersonian concept of the "good sense of the people" implies an ability to make decisions about the direction of the society.

There are some important issues to be considered if we desire a humanistic program of construction technology in industrial arts. First, we must move away from the idea of "shops" toward a concept of "laboratories." The term shop, appropriate in earlier times, no longer fits industrial arts in the post-industrial age. It carries the connotation of skilled and semi-skilled activity performed in a routine fashion. In contrast, a laboratory is an environment where purposeful discovery takes place. For the child in industrial arts, at least two types of discoveries occur. There is an awakening of the self, that is to say, becoming a more complete person. Next, the student gains insight to the industrial and technological world. This description is clearly part of the tradition of the activity-based concept and is consistent with the intellectual and behavioral necessities for living in a post-industrial world.

Construction under the laboratory approach would no longer be limited to carpentry taught in a wood shop or pseudo architecture via some undirected or overly-directed drafting plate. It would be a program which deals with the full range of societal problems

and opportunities facing mankind. Thus, some of the topical areas would include housing, transportation, power generation and resource utilization.

Construction technology education may take various forms while using the activity-based concept. For example, it might be studied as a fourth technology cluster with power, production and graphic communication. Another approach might be through individual units such as housing or transportation. Whatever approach is taken, the activity-based concept should serve as the foundation for the program if it is to be true industrial arts.

Technology is an essential part of any people's culture. Construction technology is an integral part of the nation's destiny and consequently should occupy an important place in the total industrial arts curriculum. Its study in industrial arts can best meet the challenges of life in a post-industrial society if we insure delivery through the activity-based concept.

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Curriculum

Developing a Leadership and Group Interaction Skills Curriculum

Bela H. Banathy

This research project examines the effects of learned cooperative group interaction skills (CGIS) on performance in task-oriented groups. The project has developed competence-based instructional materials to teach CGIS and is testing the effects of giving high school students training in these competencies.

The materials developed by the project enable the teacher to establish and train task-oriented small groups in a variety of settings. These materials facilitate student growth in areas such as adjustment to task-oriented settings, effectiveness in group performance, satisfaction and self development in group functioning, decision making, problem solving, interpersonal communication and conflict resolution.

Specific products of the project include:

- A classification of learning tasks, designed to provide a basis for curriculum design in cooperative group interaction skills and in understanding how groups function.
- A curriculum consisting of simulation exercises, problem solving activities for groups and supportive materials (i.e., guides, manuals, props) designed for secondary school level students.
- A research paper on the effects of the experimental curriculum on a sample student population together with descriptions of the project strategies and activities.

RATIONALE AND SPECIFICATION

Our rationale for developing the leadership and group interaction skills curriculum for schools was based on the general proposition that there is a need in schools for a curriculum which focuses on the specific skills and attitudes which are necessary for the successful functioning of individuals in societal groups and particularly in economic organizations.

The individual in our society is faced with increasing demands for competent performance as a member—and often as a leader—of groups. Many young people have problems adjusting to, and working effectively in, the various groups encountered during and after formal education. Such groups include the family as well as various peer and societal groups—for example: recreational, political, and fellowship, interest-related and community-oriented groups.

When a person enters the world of economic organization, he needs to possess three kinds of competencies. The first kind is comprised of a set of basic cognitive skills and the information/knowledge base that constitutes the common cultural base of our society. Most of the school's curriculum addresses this domain of human capability. The second domain is comprised of technical competencies which enable him to perform the activities he is to carry out while functioning in a career. To be an electronic engineer or an electro-mechanical technician, for example, one must possess a certain set of technical skills. The third domain may be called life skills competencies; it is generic to all work and careers. This domain is looked upon as the common core of vocational and career education. It is comprised of three subsets. One set might include basic work habits, career decision making skills, job seeking and getting skills and work values. The second set includes everyday life skills and habits. The third set is comprised of those competencies which enable him to work in concert with others.[1] It is this latter set of competencies that we addressed in our curriculum design. Since cognitive and technical skills are of no use if they cannot be applied in cooperative efforts with other persons,

the interpersonal and group skills needed for cooperating with fellow employees are most important. A person's career—finding, maintaining, and advancing in employment—depends a great deal upon his command of group interaction skills, his ability to work cooperatively with other people. Persons who cannot communicate, build meaningful relationships, or manage conflicts constructively are not selected for retention and promotion within economic organizations.

The proposition that both technical and human skills need to be emphasized in vocational and career education programs is derived from an understanding that, while our economic system is based upon the cooperative nature of humans, the socialization processes by which cooperative skills and attitudes are learned is rapidly changing. The influence of the family in the socialization process is rapidly decreasing, and the need for educational programs which emphasize socialization is increasing.

SALIENT CHARACTERISTICS

Salient characteristics of a Leadership and Group Interaction Skills Curriculum include the following:

- The curriculum, a clearly defined domain of the program of the school, should have its own set of goals and objectives, content, learning experiences and assessment means and methods.
- It should be integrated with other domains of the school's program, such as the cognitive, technical and life skills, the attitudinal domain, the information/knowledge base, and other adaptability skills.
- If the program of the school is structured in subject matters, it should be fused with those.
- It should be implemented from the very first day of school and continue throughout all levels, with special emphasis placed on it whenever career and vocational education is introduced.
- The longitudinal scheme for this curriculum is the spiralic model, revisiting the skill areas but expanding the skill and its application, learning in more depth and at a higher level of competence.
- Being a skills curriculum domain, it should be introduced through problem exposure, implemented as skill learning, and practiced through skill application.
- It should be presented in the functional context of in- and out-of-school, real-life situations, in situations and tasks which are relevant and meaningful to the learner.

A REVIEW OF THE R&D PROGRAM OF THE PROJECT

The R&D program of the project has been carried out in six phases:

- research and analysis
- curriculum design
- materials development
- pilot testing and revision
- field testing
- analysis of findings and reporting

Research and Analysis

As in most research projects, an early activity was to review and analyze the research and development in such areas as group participation or group functioning in a task or work setting. Further, the staff sought to collect the views of the various constituencies involved in the study (students, teachers, school administrators, employers, parents and employees).

Thus, there were three distinct directions in which the analysis activities went:

1. A review of the research literature on leadership development and group participation processes in the work setting, including such various aspects of cooperative group interaction as peer interaction, group decision-making and communication
2. A review of materials used by industrial, government, military, volunteer and other organizations for training in cooperative group interaction skills to obtain specific skill and understanding clusters which would contribute to the basis of the experimental curriculum
3. Having identified cooperating school sites, discussions with teachers, managers, employers,

students, school counselors, parents and others familiar with the students' personal and social adjustment to work settings (both informal discussions and structured questionnaires were used)

The review of research was extended and combined with material developed previously to produce a comprehensive review of the literature on leadership and cooperative group interaction skills development.

Design

The design of the experimental curriculum commenced with the construction of a curriculum map, which displayed the "universe" of leadership and cooperative group interaction competencies. A study of this map led to the selection of a specific set of competencies to be addressed by the experimental curriculum. In addition, a prototype module was designed based on a subset of those competencies. The curriculum map and the prototype module were presented for critique to consultants and cooperating school personnel in early November. An Internal Review Panel — of the Laboratory — also reviewed design information and provided feedback to the project staff.

Thus, the final design decisions were based upon the input from three sources: school site personnel, consultants, and the Internal Review Panel at Far West Laboratory. The final design decisions were made relevant to the format for the pilot test version of the instructional modules and identification of the precise competence areas to be addressed by the materials which the project would develop.

Development

Following these design decisions, the project staff moved into full development of the instructional modules. The project staff approached the development task as a team: Planning sessions to outline a module; one staff member develops a draft from the outline; the draft is reviewed by other staff members and revisions suggested; and the revisions are made and the preliminary pilot test draft submitted to the site personnel. The school site personnel have also had direct input in the development. Though the instructional goal of the module may be group communication or conflict resolution, the context of the instruction is tailored to the site. For example, the Mesa Verde High School materials were developed in a business management context, while the materials used at Far West School were developed in the context of an advertising company.

For the pilot test, the components of an instructional module were (1) teacher materials which detailed the instructional strategies and activities which include a checklist to assist the teacher's observation of the group; and (2) student materials in the form of handouts which explained role play or simulation, presented basic information, and facilitated self and group evaluation of performance. Additionally, a form for teacher evaluation of the module was included.

In each module, the learning experiences fell into three phases, problem exposure, instructional phase and application phase. The problem exposure phase was typically a simulation or role play design to introduce the competence area to the students and to motivate them to want to explore it. The instructional phase presented the basic knowledge and developed the requisite skills and attitudes of the competence area. At the conclusion of this phase was the instructional test which assessed the students' mastery of these concepts. The teacher used this measure to determine whether the students were prepared for the application phase. In this phase, the group would tackle a problem, developed by them and the teacher, which required the application of their newly acquired skill to tasks drawn from their own context. (The teacher materials suggested exemplary problems, but encouraged the teacher to help the group select one clearly relevant to them.)

Following the application phase, the students would develop a Personal Growth Contract in which they would outline specific ways in their daily life that they would attempt to develop the competence further. This contract was with themselves, and the teachers simply help them monitor their own progress. It was an opportunity for the students to accept responsibility for their own personal development.

Pilot Testing and Revision

As the project staff began producing the draft of the experimental curriculum materials, these materials were pilot tested in three very different settings. This test was not a formal, structured test of the entire program. Rather, it was an effort to get these

rough materials to teachers and students during the late winter and spring of 1975 to provide the project staff with formative evaluation information so the materials could be revised and prepared for field test during the fall of 1975. Thus, the staff sought to have as many of the modules as possible used in at least one setting.

As is the usual procedure, the objective of the pilot test was to assess the materials in as discrete units as possible. Thus, the staff sought data regarding how students and teachers reacted to specific activities (did they like them, did they accomplish the objectives) or generalized reactions to a module. This formative evaluation information was invaluable in the revision of the materials for the field test.

During the pilot testing, materials from this project were implemented in three school districts. At Mesa Verde High School in Citrus Heights, California, the materials were used in a business management class in the vocational/technical cluster. In the Berkeley Unified School District, the curriculum was pilot tested in an office experience class at Berkeley High School and in the office skills program at the Vocational Education Center. The third pilot test site was Far West School, a career education high school operated by Far West Laboratory for the Oakland Public Schools under NIE's Experience-Based Career Education Program.

Based on this pilot testing, revisions were made in the materials. There were numerous changes in specific activities and the module layout, as well as a few program-level adjustments.

Field Testing

During late spring 1975, the staff addressed the issues of design and instrumentation of the field test and logistical arrangements to set up field test sites.

The field test design called for an assessment of the impact of the curriculum at the following levels: the employment community, the school as an institution, the instructional level, the learning experience level and the impact of learning. Each level is subdivided into specific purposes for the evaluation (user satisfaction, feasibility, effectiveness and/or usefulness). These purposes were then prioritized and the specific information to be collected was identified. Beyond this point, the design specified the source of the information, the procedure and timing of data collection, the person(s) responsible for data collection and analysis/interpretation.

Participating field test sites include: the Mesa Verde High School, Citrus Heights, California; the Neah-Kah-Nie High School, Rockaway, Oregon; the Mt. Diablo School District, Concord, California; and the Campbell Union High School, Campbell, California.

Analysis of Findings and Reporting

Field test results are being collected during spring 1976, and findings analyzed and reported in June 1976.

A DESCRIPTION OF THE EXPERIMENTAL CURRICULUM

Introductory Activity

Purpose

To expose students to some of the problems of group functioning.

To introduce the nature and goals of the curriculum.

Module I: Group Communication

The general purpose of this module is to help students acquire skills, knowledge and attitudes that will enable them to communicate effectively within their group and with other groups. The activities in this module are designed to help students (1) identify the ways we can communicate; (2) discover obstacles to effective communication; (3) relate effective communication to group performance and group cohesion; and (4) apply what they have learned to real tasks.

Module II: Resources of the Group

The general purpose of this module is to help students learn how to identify and use the resources of their group in order to perform a given task. The activities in this module are designed to help students (1) establish a broad definition for the term "resource"; (2) identify personal and group resources; (3) understand how resources can be used to improve group productivity and to maintain group cohesiveness; and (4) apply what they have learned to given task situations.

Module III: Conflict Resolution

The general purpose of this module is to help students acquire skills, knowledge and attitudes that will enable them to resolve conflicts effectively within their group and with other groups. The activities in this module have been designed to help students (1) establish a broad definition for the term "conflict;" (2) identify five causes of conflict; (3) clarify their own values and understand and respect the values of others; (4) develop a method based on awareness, analysis and action to resolve group conflicts; (5) understand how conflict resolution can improve group productivity and maintain group cohesiveness; and (6) apply what they have learned to real tasks.

Module IV: Planning

The general purpose of this module is to help students learn a planning process which can be applied to either group tasks or individual activities. The activities in this module have been designed to help students (1) define a task; (2) consider available resources; (3) consider possible obstacles in the situation; (4) consider alternatives; (5) determine the basis on which to select a plan; (6) choose a plan; (7) consider the details; and (8) evaluate their planning.

Module V: Evaluating Group Performance

The general purpose of this module is to help students learn a process for evaluating group performance. The process also can be adapted to evaluating individual performance. Group performance is evaluated in regard to two main aspects, accomplishment of the task and maintenance of group cohesion or unity. Students are helped to arrive at criteria for judging or evaluating group performance and then to judge performance according to those criteria.

Module VI: Leadership and Power

The general purpose of this module is to help students learn some qualities of leadership and study some effects of the use and the misuse of power. Students will also study some bases of power and will be introduced to the concept of shared leadership.

Module VII: Decision-Making

The general purpose of this module is to help students learn some different ways in which decisions can be made in a group. The way of decision-making (in particular, the person or people chosen to make the decision) must be appropriate to the decision and the situation if an effective decision is to be made. In addition to studying seven ways of decision-making and the advantages and disadvantages of each, students learn to identify factors in a situation which can help them choose an appropriate way of decision-making and to evaluate decisions they have made in terms of effectiveness.

Module VIII: Cooperative Effort

The general purpose of this module is to help students learn some ways of helping cooperative effort within a group. A group can maintain a high level of cohesiveness and efficiency only if all its members help in the cooperative effort. Since this is a summary module, students also are shown ways in which all the group interaction skills they have studied in the CGIC curriculum are useful and necessary for helping cooperative effort in a group.

Footnote

1. A set of cooperative group interaction competencies might include the following:
   - knowing the characteristics and resources of the group and using group resources
   - planning and working with others in accomplishing joint tasks
   - evaluating task accomplishment and group performance
   - communicating effectively with each other
   - building and maintaining empathetic relationships with others and motivating others.
   - resolving conflict situations
   - sharing and assuming leadership functions
   - setting examples and representing the group
   - acquiring attitudes and sensitivities related to performing in groups — as described above.

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The Impact of an Expanding I.E. Program on the Comprehensive High School Program

Eugene Brady

Several factors have given impetus to the need to re-evaluate the position of industrial education (I.E.) in the curriculum of a comprehensive high school. Students graduating from high school today are faced with an uncertain employment and economic situation. The economy is beset by a serious inflation problem, yet we have one of the highest unemployment problems in our nation's history. The time-honored method of a college education as a means of upward mobility no longer provides assurance of job security. The potential lifetime earning capacity of a skilled worker is approaching that of a college graduate, and the skilled worker is often more readily employable. All of these factors are causing students to have increased interest in industrial education.

The concept that students should have a saleable skill is not necessarily new. The vocational programs developed under the Smith Hughes Act, a limited number of technical high schools and the emergence of area trade schools are all based on this precept. Yet society has given more than token support to these programs only within the past 15 years. As a result, only a few individuals and companies have been willing to accept the tenet that the development of one's skills alone, or in combination with academic training, was a desirable goal.

This changing concept of education has had an important impact upon the I.E. program. No longer does the I.E. classroom serve as a holding room for the unmotivated, the academically untalented, or students with disciplinary problems. Granted, some of these are still found in the I.E. classrooms; but they have been joined by a more representative sample of the high school population.

Nor is the I.E. program devoted to turning out lamps, cribbage boards, and bookcases. These activities are not inherently bad. There well may be a need for traditional woodworking classes in the curriculum, but there is also a need for a curriculum in which students have an opportunity to develop saleable skills. This includes accepting the responsibilities associated with holding a full-time job and to understand the functioning of our industrial world.

These are educational experiences that only a few years ago seemed unattainable except in the most sophisticated of the vocational schools. Fortunately, they do not have to be. By careful planning and by utilization of school and community resources, a school can develop a more comprehensive approach to industrial education.

I would like to cite the industrial education program at Perry High School as an example of a skill-centered program in a small high school, not that this program is without flaws, nor that it should be replicated by other schools, but with the hope that other schools will analyze their own resources and develop a program that meets their own needs.

A brief review of the community and the school may provide some background for this presentation. Perry is a small rural-oriented city of approximately 7,000 people. It is situated approximately 40 miles northwest of Des Moines in a rich agricultural area. Its main industries are agriculturally related, the major employers being Oscar Meyer Pork Processing Plant, Osmundson Foundry, Wiese Foundry, and the Milwaukee Railroad. In addition, there are the numerous small businesses typically found in a city of this description. As might be expected, the citizens of the area are middle class with a traditional middle-class value system.

Perry High School is composed of grades 9-12, with a student population of approximately 630 students. There are 41 full-time professional staff members. Over the past six years the curriculum has expanded until there are currently 128 courses available to the students.

In order to provide this variety of classes, the high school operates on a trimester schedule. Each trimester is composed of 60 days, and each day is divided into 7 periods of 52 minutes each. While an instructor can elect to have classes that last 12, 24, or 36 weeks, the majority of classes follow a 12-week pattern. Normally a class meets for 52 minutes, 5 days a week. However, with the I.E. program some modifications have been made. The automobile mechanics courses and the building trade courses meet for 104 minutes 2 days a week and 1 day a week for 52 minutes. Students in the on-the-job training have either 2 or 3 periods each day in which they work outside of the building. Some work considerably more hours than this, either before or after school.

A visit to our school would reveal a typical Iowa student body. Last year (1975) about 35 percent of the students continued their education at a four-year institution. Another 15-20 percent enrolled in some type of trade school. These figures are down about 10-15 percent from 10 years ago, a decline that is characteristic of the nation as a whole. This means that about 45-50 percent of the students entered the job market or military service upon completion of their high school career. But more importantly, it means that these students became a part of the labor force equipped only with the skills they have learned at home, in school, or through other randomly-related experiences. It was with this group in mind that the modifications in the I.E. program were begun. As the program has developed it has become apparent that the impact has been felt by a much wider segment of our school population.

Six factors have had an influence upon this program and indirectly upon the total academic program at Perry High School:

1. the direction and scope of the I.E. curriculum
2. staff requirements
3. graduation requirements
4. student enrollment
5. impact of the I.E. program on the other departments
6. student retention rate

In 1965, the Perry I.E. department was comprised of one full-time instructor and a second instructor who was shared with the art department and the junior high school I.E. department. Classes were held in a shop area located in the junior high school. Every student enrolled in the program was bused from the high school to the junior high school six blocks away. Busing, teaching and clean-up was accomplished in a 56-minute time block. The curriculum might, at the best, be described as exploratory in nature. Course offerings were limited to Drafting I and II, Metals I and II, Woods I and II and General Shop. The duration of each course is two semesters.

The commitment to skill development was limited. During the 1965 school year, only 86 and 83 students were scheduled for first and second semesters, respectively. Nevertheless, the program was certainly comparable in scope and caliber to programs in schools of similar size.

A decision was made to change the program from an exploratory to a skill-centered program. Further, it was decided that the student should be provided an opportunity for on-the-job training (OJT). The program and the curriculum developed within these guidelines. It is doubtful if anyone in 1965 fully envisioned the type of curriculum that is presently being offered.

The current I.E. curriculum can be perceived as functioning at three levels: general exploratory, skill development and on-the-job training.

The exploratory courses are designed to acquaint the student with a general area of industrial education. These courses provide basic skills; of equal importance, they provide students with an opportunity to match their interests, abilities and aptitudes with a particular field. Presently, there are seven exploratory courses being offered. (See Table 1)

Many of the students who enroll find that the exploratory courses do not provide them with the depth of understanding they desire. Consequently, they select one or more skill development courses. These courses place a high degree of emphasis on developing a thorough understanding of the area as well as developing the necessary manipulative skills. A list of these courses is provided in Table 2.

Table 1. Exploratory Courses Offered in 1975-1976

Course	Topic	Duration in Trimesters
Power Mechanics	Basic principles of power production	1
Intro to Auto Mechanics	Operation of motors, minor service, basic systems	1
Metals I	Bench metals and use of necessary hand tools	1
Foundry	Making of patterns, castings and the types of metals used	1
Farm Mechanics	Basic repair and services used in farming	1
Home Mechanics	Small appliance repair, home maintenance, refinishing	1
Industrial Math	Practical application of Math to I.E. situations	1

Table 2. Skill-Centered Courses Offered in 1975-1976

Course	Topic	Duration in Trimesters
Drafting I	basic drafting techniques, lettering, and use of instruments	1
Drafting II	pictorial representation, section developments, revolutions and intersections	1
Drafting III	engineering graphics	1
Drafting IV	architectural drawing	3
Building Trades	masonry construction, mechanical construction, framing and actual building construction	3
Power Transmission	power transmission: mechanical, hydraulic and pneumatic operations	1
Auto Mech I	theory of operation, overhaul and service	1
Auto Mech II	transmission, braking, steering	1
Auto III	tuneups, air conditioning, exhaust system	1
Auto IV	electrical and fuel systems	1
Electricity	basic laws of electricity, magnetism, generators, motors and wiring	3
Metals II	sheet metal, wrought iron	1
Metals III	advanced foundry, oxyacetylene welding	1
Welding	basic techniques of welding	3
Machine Shop	introduction to the tool and die field	3

In a survey, Mood of Youth Notes, conducted by Hereff Jones, 95.5 percent of the students 18 and over felt that work experiences were an important aspect of their education. This trend is evident in Perry High School. Of the 154 seniors, 61.2 percent are involved in some phase of OJT. Of these, 35.7 percent are in T & I, 18.2 percent in D.E. and 7.3 percent in O.E.

The growth of the OJT phase of the I.E. program has occurred at a rate exceeding the staff's highest expectations. From a very humble beginning in 1966, the program has continued to grow to its present level. There seems to be some evidence that the program is now stabilizing, and current enrollment will remain relatively static.

As the program developed, it became evident that there was a need to provide job experience in health-related areas. While these types of experiences do not relate directly to I.E., it was felt that the T & I program was the most logical area to place these students. As a result, a separate related class was designed for these students.

A city the size of Perry does not have a ready-made set of training stations. These stations develop only by careful analysis of the potential stations and a large amount of public relations. To a degree, the skill areas of the curriculum must be directed toward the needs of these training stations. It can be argued that this is a provincial attitude, that students do not remain in the immediate vicinity of where they take their training and that a school should provide students with more global skills.

Had the department accepted this premise, the program would never have been considered, much less implemented. The wide variety of skilled jobs associated with a metropolitan area are not available in a city of 7,000. The questions then become: Is some type of skill development better than none at all? Can skills developed in one area be readily transferred to a second area? Can an understanding of industry be gained in a community with a limited number of quality training stations? The answer to all three questions seems to be yes.

Follow-up studies have been conducted by Mr. Tom South, coordinator of the T & I program. These studies indicate that the skills and training gained within the program have been of value to students in later life. From September 1965 to May 1976, 381 students have been enrolled in the T & I program. Of these 381 students, 92 percent are currently employed, in service, or are enrolled in some phase of post-secondary education. More specifically, 74 percent are employed in a trade and industry-related field. But of particular interest to the Perry program, 50 percent of the students have remained in the type of trade in which they were originally placed. Based on this survey, the T & I program would appear to be meeting a training need within the community and, at the same time, preparing students with a saleable skill.

There are valuable training stations in a town of this size. By careful selection and a high degree of cooperation between school and training stations, a meaningful work experience can be developed for high school students.

Involvement of this many students in OJT does not occur without some problems arising. These problems not only affect the individual student and the T & I program, but they have ramifications for the entire school. These problems can be categorized as follows:

1. The school becomes an employment agency

It is not possible to ascertain fully the motives of a student entering the program. However, several precautions are taken to insure that a student warrants placement in the program. During the student's junior year, each one undergoes a preliminary screening. This screening attempts to identify the student's future goals and the reason for seeking vocational training. After the preliminary screening, each student must be interviewed by the prospective employer. Here the student is brought face to face with the realities of what the job will entail. Either the employer or the student may decide that the placement is not desirable.

Finally, each student is placed on a three-week probationary period. Again, if either the student or the employer feels the placement is wrong, the student will be removed from the job.

2. A regular class cannot compete with a class that pays at least minimum wage

A variety of factors interact to make OJT attractive: The freedom to leave the building, an opportunity to participate in productive work and, last but not least, financial reward. In many cases, students will rearrange their schedules or drop classes that are of importance to future vocational classes. But this is true of students who are not enrolled in OJT and who have open campus. In the past year there have been some indications that students are doing a better job of class selection. More seniors are opting for five classes, many of which are college preparatory. The trend seems to be toward a combination of academic and vocational classes that provides balance between the traditional high school courses and work experience.

3. Employers become dependent upon vocational trainees

Some employers come to view the trainee as an integral part of their establishment. To a large extent, this is good. Yet in some cases it has posed a problem when the

employer wants to take the student out of the regular classroom for additional work. Cooperation between school and the employers, plus a little public relations work on the part of the coordinator, has reduced this to a minimal problem.

4. Students spend too much time at their training stations

To qualify under the national program, students must work 15 hours per week. Students involved in the T & I program work an average of 25 hours a week, with 8 students working a 40-hour week. The 15-hour minimum does not pose any serious problems for the school or the student. However, as the number of hours worked goes up, the problems increase proportionately. Increased time on the job means less study time, less time for involvement in activities and, at the 40-hour level, a noticeable lessening of the student's vitality. It may be that a maximum as well as a minimum number of hours a student can work should be set.

5. On-the-job training interfers with school activities

Students involved in OJT sometimes find it difficult to be involved in extracurricular activities. The student who wishes to work four or more hours each day and carry three additional courses may find it difficult to work in band and/or choir. Athletics may be omitted because students feel rushed for time. Nevertheless, this is a problem that can be solved. Students in T & I can be placed either in the morning or afternoon, depending on the activity in which they desire to participate. In most cases, employers have been willing to schedule around these activities. In those cases where the student has opted not to participate, OJT has served as the excuse; but it is not necessarily the cause.

How serious these problems are and to what degree they diminish the school program is largely determined by the philosophy of the individual. How one perceives the function of the school and what one considers to be of educational value becomes the yardstick for measuring the merits of the program. Little or no criticism has been leveled at the exploratory or skill-centered courses, and as the OJT program has become better established, criticism in this area has diminished.

To a large extent the curriculum reflects the philosophy and the competency of the staff. If the goal of the department is skill development, then it is imperative that the staff members have the ability to teach these particular skills. Thus, to have a skill-oriented curriculum it is necessary, through selective hiring, to bring together a staff that has the needed competencies.

Two factors, training and experience, interact to bring about this competency.

Our experience has been that the practical experience or the knowledge gained from short courses sponsored by commercial companies has been, in many cases, of equal or greater value than the academic courses offered by the four-year institutions. Much of this training has occurred without it being recognized by the Perry School System, at least in terms of the salary schedule, or the state in terms of certification renewal. If a school is committed to the philosophy that vocational training is worthwhile for students and that meaningful education can occur outside the schoolroom, then it would seem to follow that some type of credit should be provided to the staff for work experience.

If the type of program at Perry becomes more common, then the colleges will have to look more closely at the type of learning activities which they offer.

A program is no more successful than the degree to which it meets the needs of students. If our I.E. program was to be successful, there was a need to have students enrolled in the various courses. In view of the fact that all of the I.E. courses are elective, some provisions had to be made to allow students to enroll in them. This was accomplished by reducing the specified number of courses for a student to graduate. The difference between 1965 and 1976 is illustrated in Table 3.

The English and social studies requirement was originally reduced to 6 trimesters each. Because of the concern over student achievement, the number of courses needed for graduation has been increased. This is a national trend, and indications are that it may well continue. If it does, the I.E. program may again be pressed to attract students. At the present time this does not seem to be a problem at Perry.

As graduation requirements have increased, the enrollment in I.E. courses has remained relatively constant. Students have elected to take more courses rather than to drop elective courses in the I.E. field. This seems to be a desirable trend. Certainly, the number of required courses must be kept at a reasonable number. There is a need for a balance betw the academic courses and the skill courses. The question becomes: Where is the balancing point? This must be answered by each individual school system.

Table 3. A Comparison of Courses Needed for Graduation

Department	1965	1976
Science	6 trimesters[1]	3 trimesters
Mathematics	6 trimesters	3 trimesters
English	9 trimesters	8 trimesters
Social Studies	9 trimesters	8 trimesters
Total	30 trimesters	22 trimesters

[1]Perry High School is currently operating on trimester plan consisting of three 12-week periods. All comparisons have been made as if the school were operating on the trimester basis.

Table 4. Enrollment by Trimester in I.E. Classes[1]

First Trimester	393
Second Trimester	316
Third Trimester	327

[1]Each student enrolled in an I.E. class is counted as an enrollee. Thus, a student enrolled in two classes is counted as two enrollments.

How has the increased number of students in I.E. affected other departments? Initially, students seemed to take one of two routes. They were either vocational students or college prep students. Consequently, there was considerable competition for students, particularly between the on-the-job training programs and the senior-level college preparatory courses. This competition has had some beneficial aspects. Many of the academic and vocational courses have been revised. Class materials and teaching methods have been updated and are more meaningful.

Secondly, there has been a change in course selection. Students are taking more of their academic courses early in their high school careers. The tendency to take a full load of college preparatory classes the senior year has been replaced by the work experience classes. But more importantly there has been a merging of the academic and skill-oriented courses. Students who fully intend on following a college career are enrolling in the I.E. courses. This is especially true if the courses are related to their college interests. More and more students who have college aspirations are electing to participate in the on-the-job training. Students have shown that it is possible to select the best of both areas successfully.

Student dropout is consistently cited as one of the major problems facing schools today. A dropout rate as high as 24 percent in metropolitan areas is not uncommon. Factors such as boredom, lack of course relevancy and need for a job are reasons given by many of these dropouts.

The I.E. program should not be conceived of as a dropout prevention program. Nevertheless, it has been part of our curriculum which has helped retain students who were potential dropouts. The greatest number of dropouts at Perry occur during the freshman and sophomore years. These students are characterized by a lack of interest in school activity, a lack of commitment to any future goal, and a weak background in the academic subjects.

In some cases, this has been compounded by a lack of parental concern for the student's progress. These students seem to respond positively to the concrete, hands-on learning experiences utilized in the industrial arts program. The fact that the program provides a direction and structure for the entire four years also appears to appeal to these students. In general, as they progress through the program they develop a more positive attitude toward the program and the school. This is often reflected in greater success in other areas.

For those schools which might be contemplating implementing such a program, I would make the following suggestions:

1. The curriculum should offer the students an opportunity to choose from a wide range of skill courses. These might include such areas as electricity, plumbing, heating, air conditioning, brick laying, or any other industrial area which requires some degree of apprenticeship.
2. On-the-job training sites should be carefully chosen with emphasis on quality learning experience of work available, rather than quantity. Job descriptions, cooperatively developed by the coordinator and the employer, should be one of the first priorities. This would allow a better matching of the student's interests and aptitudes and the learning experiences associated with the job.
3. Consideration should be given to coordinating the program with existing vocational training programs in the area. There seems to be little research relating to the question of where at what time a particular skill can be taught most effectively.
4. The implementation of a program of this type is costly compared to the more traditional secondary programs. We have been fortunate to have the support of the industrial plants located in Perry. As a result, they have provided some equipment that might not have been available if the school had been required to make the purchases at the inception of the program.
5. Finally, I think there is a need to sequence carefully the types of learning activities that are developed for the students. As the skill courses become more complex, there is a danger that they will become more abstract. It may be well to match student maturation with the complexity of the learning skill being developed.

In retrospect, the I.E. program has provided a successful learning environment for a significant segment of our students. The combination of work experiences and skill development has been successful in our school through the efforts of the I.E. staff and the cooperation of the community.

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A Continuum of Objectives: The Way to More Systematic Instruction

Michael J. Dyrenfurth

Prior to the disclosure of this presentation's basic premise, it will be necessary to outline the following precepts:

1. All programs subsumed by the term industrial education have an identifiable slate of major goals.
2. An educational system (you may substitute program or course if you wish) necessarily consists of a set of sequential teacher activities that coincide to some degree with a set of student experiences.
3. Since our focus is on the formal and intended aspect of education and since education should be additive at the very least and preferably synergistic, it necessarily follows that the best possible outcome of a program or course is at least equal to the sum of the individual student experiences in that program or course.
4. A corollary of #3 is that, serendipity not withstanding, it would be useless to expect students to achieve objectives not built into a program or course.

This brings us to the basic premise of this presentation. The sum of the activities, and the objectives attained thereby, that students encounter in their industrial arts classes typically do not add up to the goals ascribed to the program. In simpler words, it is the author's contention that many teachers of industrial arts are failing to achieve the program goals that they claim to address.

POSSIBLE CAUSES

One possible reason for the situation characterized by the premise is found in contemporary industrial arts practice. The presenter's personal observations, resulting from a wide variety of student-teaching supervision assignments, suggest rather forcefully that industrial arts instructors frequently select activities on the basis of one or more of the following categories of expedience. Note that none of the categories are considered sufficient in and of themselves!

1. Convenience: A teacher assigns an activity that's easy for the given situation existing at that time.
   e.g.: Paint the laboratory! Sort type! Do a chore for the teacher! Etc...
2. Necessity: Something that, while typically the teacher's responsibility, is assigned to a student who accepts it because the instructor is perceived as an authority figure.
   e.g.: Sort these purchase orders by date of issuance! Pick up these supplies for me! I'd like you to repair this machine for me. Etc...
3. "Brownies": An instructor assigns a student some work that directly benefits someone else, typically an administrator or other faculty member, more than the student.
   e.g.: Please fix this drawer for the principal! Set up this poster on the sign press, the band needs 500 by tonight! Etc....

Now while many more categories of faulty reasons for selecting student experiences will certainly come to mind, the following point has hopefully been made:

The path of least resistance is a common way of deciding what activities industrial arts students experience.

Undoubtedly by now the defense mechanisms of the reader are marshalling. To be sure, it is possible that desirable learning experiences could result from the three listed causes. But, the last time you used one of these activity selection devices, can you be intellectually and professionally honest and state categorically that student achievement of course program objectives was the PRIMARY reason for assigning the activity in question?

Another contributory cause for the premise, and perhaps one that is more palatable than the previous notion, may be found in the lack of precision with which we state our objectives. To make this point, I will paraphrase an observation by Popham (1) as follows:

> Industrial arts instructors may ascribe "professional and eminently worthwhile objectives" to their course (such as: To introduce a student to the three major clusters of industrial technology, or perhaps to instill appreciation of craftsmanship) Yet beneath such facades of profundity, many teachers are aiming at extremely trivial kinds of pupil behavior changes.

A paper describing the Evaluation for Individualized Instruction Project (2) also addresses itself to the problem caused by the lack of specificity in goal statements.

> The vagueness of our goals often promise the idea that "anything goes." Without a guiding beacon many classrooms become activity-centered rather than goal-oriented. One educator recently compared the all-too-typical classroom with Henry Ford's observation concerning history. He defined history as, "One damned thing after another." Is this true of the succession of activities within our classrooms? Does the teacher really know the educational purpose of each activity? Perhaps even more importantly, do the children know the purpose?

Briefly then, this second possible cause for the premise may be summarized as follows:

1. Teacher-selected activities do not add up to achieve the desired objectives because the lack of detail in the statement of course goals allowed selection of trivial activities.
2. The lack of specificity in our statement of objectives, when combined with the activity-centered perspective so crucial to industrial education, simply causes selection of activity for activity's sake. This is best exemplified by the "Keep them busy" attitude!

THE CONTINUUM OF OBJECTIVES: A CONSTRUCTIVE APPROACH

The situation described in the previous section and the premise it originated may be addressed in several ways, only one of which will be detailed here. It is the author's position that a continuum of objectives will tend to prevent poor curricular decisions, at least those due to expedience and ambiguity.

WHAT IS THE CONTINUUM OF OBJECTIVES?

Simply stated, a continuum of objectives is merely the product of an instructor's interpretation of course goals. Furthermore, it is a graphic representation of the link between program goals and specific behavioral objectives.

In its simplest form, a continuum of objectives involves the listing of program goals at the left of a page with a decision-tree type of network branching out from each goal in a pattern of ever-increasing specificity. Only broad program goals are listed at the left. These goals are viewed by curriculum designers and/or instructors in a particular light specific to the local situation and perspective. This has the effect of allowing program goals to be locally interpreted by instructional planners with their particular conceptual framework or mind set. The result is a set of general objectives for the local programs.

Once the general objectives are stated, each is further delineated by identifying a number of intermediate objectives, until the desired specificity is attained. Contemporary systems theory suggests that the required precision demands the identification of the entire set, or a significant and representative sample thereof, of behavioral objectives attributable to each program goal.

This systematic approach requires the eventual, but certainly pre-instruction, specification of one or more alternate learning activities by which it is anticipated the student will attain each behavioral objective.

EFFECT ON THE QUALITY OF INDUSTRIAL ARTS INSTRUCTION

The following listed benefits are claimed to result directly from the development and use of a continuum as described. While some attributes will undoubtedly be obvious from the initial definition of the continuum, others may require quick reference to the next section (describing the continuum building process) before becoming crystalized.

1. To insure comprehensiveness: By forming definitions of each larger goal/objective, the use of the continuum guards against the omission of any significant portion of a goal.
2. To facilitate logical structuring of objectives and activities: The extrapolation process directly assigns one or more specific objectives to a single larger, more comprehensive objective.
3. To eliminate initial planning errors: As the continuum evolves, initial classification errors become obvious due to repetition and/or absurdness of the behavioral objectives.
4. To facilitate communication of intent: The graphic form of detailing allows students, faculty, and administrators to see all individual activities and their contribution toward achievement of over-all program objectives.
5. To facilitate the individualization of instruction: By detailing individual behavioral objectives free from methodological considerations, and in advance of instruction, the teacher is allowed to concentrate on the selection of appropriate delivery systems and activities most suited to each student.
6. To facilitate evaluation: Evaluations keyed to one or more specific behavioral objectives are easily assigned, and those objectives not addressed are self-evident. Subsequent evaluations are then targeted on the remaining objectives.
7. To facilitate motivation: By demonstrating the significance, in the light of over-all program goals, of each behavioral objective and activity, the necessary perceived purpose is created more easily.

HOW DOES ONE DEVELOP A CONTINUUM OF OBJECTIVES?

The continuum is a graphic illustration of the links and, more importantly, the logic extending from loosely stated program goals and the necessary specific behavioral

objectives and their attendant learning activities. In all cases when building a continuum, the procedure is to:

1. Identify accepted and comprehensive statements of program goals. These statements should be phrased to be as mutually exclusive as possible.
2. Subsequently, the identified program goals must be interpreted in the context of the specific local situation. This interpretation procedure translates program goals into a set of general program objectives. Be careful to note that the translation process does not permit either the omission or addition of major goals, but rather allows a local emphasis to be applied.
3. Once general program objectives are outlined, they must each be defined by a series of ever more specific intermediate objectives until an inclusive set of behavioral statements is reached for each program objective. This chain of ever more specific (when progressing from left to right) statements may be arrived at by applying one or more of the following questions to left-positioned objectives:
   A. What categories are subsumed by the item at the immediate left?
   B. How can the item at the immediate left be detailed?
   C. How can the left hand statement be defined?
   D. How else can the left hand objective be worded?
   E. What is meant by the left hand objective?

   Another important feature that contributes to the flexibility of this technique is that the flows emanating from each of the program objectives need not have the same number of intermediate objectives, as long as they each end in behavioral statements.
4. Once the behavioral statements have been delineated for each program objective's flow, the instructor begins to apply his skills in the methodology arena by:
   A. Planning appropriate evaluative methods for each behavioral statement.
   B. Setting criteria for each behavioral statement.
   C. Outlining alternative learning activities by which students can achieve the required level of performance.
   D. Organizing the learning activities into a set of instructional units.

HOW DOES ONE USE THE CONTINUUM OF OBJECTIVES?

1. To plan curricula systematically.
2. To test the logic between goals and activities.
3. To communicate the content and intent of instruction to students, faculty and administration.
4. To allow students to follow their progress in the light of a comprehensive perspective.
5. To coordinate division of program activity into appropriate courses.

FOOTNOTES

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The Iowa Plan for Curriculum Improvement in Industrial Arts

Ronald Bro and Roger Foelske

In spring 1973, the Executive Board of the Iowa Industrial Education Association held a series of meetings with Iowa State Committee on Industrial Arts Teacher Education for the purpose of charting a joint effort to improve industrial arts programs in the state. As a result of these meetings, a project proposal was drafted and submitted to the Career Education Division of the State Department of Public Instruction. Essentially, the proposal called for development of a new state curriculum guide and an assessment of further needs regarding implementation of the guide. The project was funded and got underway in fall 1973, and was completed in summer 1975. The needs identified in the course of the project resulted in additional support of funding from the State Department to assist in implementing the major concepts embodied in the guide. A general description of how the guide was developed, its content and strategies for implementation are presented here.

THE DEVELOPMENT OF THE GUIDE

There were two principle committees involved in the development of the guide — the Project Committee and the Investigative Team.

The Project Committee had the major responsibility for coordinating efforts, compiling information, editing materials and determining the final format. Its membership represented industrial arts teachers on the elementary, junior high and senior high school levels, as well as industrial arts supervisors, teacher educators and consultants. The co-directors of the Project Committee were Barry DuVall from Iowa State University and Ronald Bro from the University of Northern Iowa.

The Investigative Team consisted of 16 industrial arts teachers from the public schools who were presently teaching the types of offerings to be included in the guide. The team was selected by the Project Committee after the basic rationale, content organizers and general format had been determined. The Investigative Team was responsible for supplying suggested performance objectives, learning activities, and resource lists for the specified offerings.

All tasks to be performed in developing the guide were identified and scheduled in PERT form. The PERT chart was a valuable instrument for directing the efforts of the task force. Major tasks included review of literature on innovative curricula, recently developed guides from other states, and professional association publications. Some of the items which were especially helpful are cited in the reference section of this paper. Other functions included consultation with resource personnel associated with innovative approaches to teaching industrial arts.

The draft copy was mailed to over 50 industrial arts teachers, teacher educators and industrial personnel in Iowa and surrounding states for evaluation. The feedback from these sources served as a basis for revision and development of the final draft. At this point a technical illustrator was employed to design the layout, make illustrations and develop the camera-ready copy.

OVERVIEW OF THE GUIDE

The guide is a framework for local curriculum improvement and thus avoids prescribing specific content and methodology. It gives the practicing industrial arts teacher the freedom and flexibility to innovate and develop unique approaches for a particular locale.

The definition of industrial arts in the guide is consistent with federal vocational legislation regarding the eligibility of industrial arts for funding as an exploratory program.

> Industrial arts is that field which provides opportunities for all students from elementary through higher education to develop an understanding about the technical, consumer, occupational, recreational, organizational, managerial, social, historical and cultural aspects of industry and technology. Furthermore, it is a field wherein students acquire industrial-technical knowledge and competencies through creative and problem-solving learning experiences involving such activities as experimenting, planning, designing, constructing, evaluating and using tools, machines, materials and processes. (4, p. 1)

A fundamental premise of the guide is that industrial arts should draw its content from industrial technology. The basis for this premise is that industry and technology are generic terms and are interdisciplinary. To structure an educational program for industrial arts, it is necessary to identify the segments of industry and technology which are operationally appropriate for this subject matter field. The operational definition of industrial technology is:

> ...the systematized knowledge derived from the nature, the principles and practices, the products, the services and energies employed by industry. (6)

Another basic premise of the guide is that while industry consists of many sub-systems, the major (dominant) systems of industry are communications, production and energy.

Two general goals were recognized as being appropriate for the entire K-12 industrial arts program. These goals are inter-related and provide unique opportunities for students to learn about industry, its occupations and associated technologies.

Sub-goals were also identified for the operational levels of elementary, junior high and senior high. These goals describe the functions of industrial arts at the various grade levels. They are classified under categories of career and industrial-technological. Examples of expected outcomes are presented for each of the operational level goals. For example, an industrial-technological goal on the junior high school level is to develop knowledge of the basic elements of an industrial enterprise.

An example of an expected outcome for this goal is:

> As a result of learning experiences on the junior high school level, the student will be able to develop a line and staff organizational structure that might be used to staff a student-run industrial enterprise.

The K-12 curriculum is based upon the pyramid concept, beginning with very broad experiences on the elementary level. At the junior and senior high school levels, the planned program narrows in scope consistent with the general maturation levels of students. The program is designed to develop career and industrial-technological awareness, insights, self-concepts, exploration and some degree of specialization.

At the elementary level the learning experiences in communication, production and energy systems are primarily correlated with other subject areas. At the junior high level courses are designed to enable the student to explore specific clusters within the basic systems. There are four cluster exploration courses recommended in the guide. They are graphic communications, manufacturing, construction and energy and power. At the senior high level, courses pertaining to particular industrial technologies are recommended. The content to be emphasized in these courses includes contemporary industrial materials, processes, organization and careers. The recommended scope and sequence of this program is described in some detail in the guide.

A major portion of the guide is devoted to selected student competencies and sample learning activities for each of the program offerings. The competencies describe the knowledge, skills and attitudes which students should be able to exhibit upon completion of the course or offering. The suggested learning activities provide the student with opportunities to practice the kind of behavior implied by the associated competency. The intent was to provide teachers with an idea bank, rather than an exhaustive list of learning activities. The competencies and learning activities are classified under cognitive, psycho-motor and affective domains.

The guide also contains a description of selected methods and approaches. Those recommended for certain programs in the guide include role playing, the group project, conceptual learning, the enterprise method, the seminar, individualized instruction and community resources. A fairly extensive list of instructional resources is also provided.

To assist teachers in developing curriculum, a model procedure was presented. Four phases of curriculum development are discussed in some detail. Phase I involves establishing a rationale for industrial arts in the total school system. Phase II concerns establishing a basis for the program on a particular operational level. In Phase III the process for developing a scope and sequence of courses is described. The actual preparation of teaching plans and strategies is described in Phase IV. Reference was made to particular sections of the guide which may be of assistance in the various phases of curriculum development.

This completes the overview of The Iowa Guide for Curriculum Improvement in Industrial Arts, K-12. The strategies for implementing the guide are described in the remainder of this article.

THE DEVELOPMENT OF THE STRATEGY

The project proposal called for an assessment of further needs regarding the implementation of curriculum improvement, as well as the development of a new state curriculum guide. As a result of the assessment, the Project Committee determined that if the practitioners were to be successful in implementing the concepts and methodology presented in the guide, inservice (staff development) should accommodate the dissemination of the guide and the development of additional curriculum material would be necessary.

A series of meetings were held in the summer of 1975 with representatives of the Project Committee, the Iowa State Committee for Industrial Arts Teacher Education, the Iowa Industrial Education Association and the Department of Public Instruction for purposes of jointly charting a master plan that would meet the needs assessed by the Project Committee to insure that the guide and its concepts would be implemented into local educational programs.

As a result of these meetings, a cadre was appointed and funded to develop and implement a staff development (inservice) system that promoted the concepts of the Industrial Arts Guide and provided assistance to the staff of local educational agencies in incorporating these concepts in the planned educational experiences for students. The cadre's membership consists of eight industrial arts educators representing junior and senior high school instructors, program supervisors, teacher educators, and area and state curriculum consultants. The co-directors of the cadre are Ronald Bro from the University of Northern Iowa and Roger Foelske from the Iowa State Department of Public Instruction.

Since the guide provided a framework and direction for local curriculum development, it was recognized that change would be an evolutionary process involving acceptance and extensive efforts on the part of industrial arts teachers and their administrators.

It was conceded that change would not occur in a revolutionary manner. The acceptance and implementation of the concepts by local instructors and administrators would likely occur only after they had progressed through various developmental stages. To assist the cadre in constructing a staff development system, a model for implementing changes was designed after researching various strategies for adopting innovations. Rogers' model of five mental phases that an individual experiences in adopting an innovation was found to be of great assistance.

Rogers' Five-Step Process in Adopting Innovation (7)

1. Awareness—user learns of existence of the innovation.
2. Interest—user develops an interest in the innovation.
3. Evaluation—user makes mental application of the innovation and decides to try it.
4. Trial—user tries the innovation on a small scale.
5. Adoption—user tries the innovation on a full scale.

The model which the cadre developed differed from the Rogers model only in that the five stages were reduced to four by including evaluation as part of each phase.

OVERVIEW OF THE STAFF DEVELOPMENT SYSTEM

Phase I – Awareness

The awareness phase of the staff development system was to provide practitioners with an opportunity to learn of the development of the guide, its concepts, and of the new directions being pursued.

This phase was successfully accomplished during the 1974-1975 school year, prior to the completion of the guide, through presentations by Project Committee members at four state-wide industrial arts meetings. In these presentations, participants were given an overview of the present status of the guide and an introduction to the major concepts

and directions being pursued. They were given opportunity for input through discussion periods following each presentation.

Phase II — Orientation and Dissemination

The orientation and dissemination phase of the staff development system was to provide participants with an understanding of concepts, methodology presented in the guide, and its implication for local industrial arts curricula. The purpose of this phase was also to generate interest in curriculum change on the behalf of local practitioners.

To accomplish this, the cadre designed and developed a multi-media workshop that is currently being presented by Area Education Agency (AEA) teams to industrial arts teachers and administrators in various geographical areas of the state. The workshops focus on the following major factors: The need for change; an analysis of the concepts presented in the guide; a tape/slide presentation of possible learning activities; the dissemination of the guide; the use of the guide in local curriculum planning; and an overview of future activities being planned to assist in its implementation.

Phase III — Development and Preparation

The cadre is presently developing Phase III. The nucleus of this phase is a series of institutes conducted by the industrial teacher education institutions. These institutes will be held in the cluster areas of graphic communications, energy and power and production. Their purpose will be development of instructional competencies, preparation of teaching materials, and designing of student learning activities needed to facilitate implementation of the recommended program offerings and methodology.

The institutes will be for practicing industrial arts teachers and will consist of two summer sessions and an academic school year. The first summer will be devoted to competency development and preparation of instructional materials. During the following academic year, the instructional materials will be field tested by the participants in their local schools. The final summer session will involve evaluation, refinement and publication of selected instructional materials.

Also during this phase, the Area Education Agencies will facilitate inservices for industrial arts teachers in their areas. To assist the AEA, a series of one-day inservice workshops are planned and presented by institute participants, and their coordinators will be available.

Phase IV — Trial and Adoption

It is anticipated that local industrial arts teachers will try the concepts on a small scale — perhaps within the confines of an existing course. Later, if their previous experiences were satisfying, they would implement on a broader scale — perhaps by complete course revision and sequences until complete adoption has taken place.

To facilitate this phase, model programs of successful programs will be identified. The previously developed instructional materials and learning activities will also be available by this time for state-wide distribution. Consultative assistance will be provided to assist and reinforce the instructors as they begin to implement their curriculum changes.

OVERVIEW OF STAFF DEVELOPMENT DELIVERY SYSTEM

Since participation of nearly all of Iowa's industrial arts instructors was considered vital to the implementation task, it was necessary to design a delivery system that would allow flexibility to meet local needs; be geographically convenient to local educational agencies; and involve the practitioners in the implementation process. The delivery system that was designed incorporated a multiplier effect conducted through 15 AEA's. One of the purposes of these agencies is to provide educational services to local schools for their observations.

This system provides for three levels of activities, with each level being responsible for the needs of the succeeding level. The first level is the state cadre which is responsible for determining state-wide needs, development of needed resources, and providing the AEA level with inservice training and resources. The AEA level is composed of 15 teams (one for each AEA) consisting of two industrial arts instructors (presentors) and one AEA consultant (facilitator). The AEA level is responsible for assessing the needs of its area and supplying this information to the cadre level, participating in the

cadre training sessions, and planning and conducting inservice activities for local teachers within the area. The third level of the system consists of local education agencies (LEA's including industrial arts teachers and supportive personnel). This is the target group toward which the total implementation process is being directed.

This completes the overview of Iowa's plan for curriculum improvement in industrial arts, K-12. Further information about any phase of the plan or more details about any of the concepts may be obtained by writing to Ronald Bro or Roger Foelske.

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Development and Implementation of a Coordinated Program of Industrial Arts and Trade and Industrial Education

Lawrence Foth

Articulation in industrial education is an often-mentioned, seldom-realized process which only in recent years has received a performance challenge. Personnel within the respective areas with which this topic deals have long been at odds relative to the functions to be served in either area. A plethora of enigmatic charges and counter charges has been bandied by parties involved in an effort to dispute the existence of a logical relationship between industrial arts and trade and industrial education. Turfsmanship of this kind has precluded an earlier understanding and acceptance of any workable arrangement for articulation.

A HISTORICAL PERSPECTIVE

Until 1969, these instructional components were managed by separate state agencies, namely the State Department of Vocational Education and the State Department of Public Instruction. Legislative mandate at that time formally merged these into a single State Department of Education. However, the problem still received no intense scrutiny until 1971. The Industrial Arts Consultant, housed in the Division of Instruction, and the Trade and Industrial Education Supervisor operated largely in contradiction of one another, not necessarily by intent, but simply because of the nature of the funding structure in the state relative to vocational education. After a great deal of discussion among classroom teachers, teacher educators and agency personnel, a model identifying the scope, sequence and relationship of industrial education concepts was presented for adoption to the State Board of Education.

That model, subsequently identified as the Kansas Plan for Industrial Education, suggests a continuum of learning experiences which takes the student through sequential steps of awareness, exploration, preparation and specialization. These steps are identified in four basic objectives, stated as follows:

1. To examine the society-industry interface and identify the components of industry, both detrimental and beneficial, that affect people.
2. To provide exploratory, problem-solving experiences which will help the student understand how tools are utilized as an extension of man's physical capabilities, thereby increasing his efficiency and earning productivity.
3. To provide occupational information concerning the wide array of opportunities provided in the world of work, information concerning both the composition of the labor force and the talents and abilities required by that labor force.
4. To provide, subsequent to occupational exploration, opportunity for the development of realistic employment skills and ultimate realization of employment goals.

These statements are presumed to fulfill the best objectives of industrial arts and trade and industrial education.

Subsequent to this re-direction, an attempt was made to identify the attitudinal and physical roadblocks that might preclude ultimate realization of prescribed objectives. These appeared to be many, summarized as follows:

1. An attitude among many administrators, trade level instructors, counselors and general public that industrial arts is busywork, a place to enroll kids who can work with their hands and not with their heads.
2. Many industrial education programs were stale, having existed unchanged for many years and presuming to "stick" subsequent generations with warmed-over content from the past in lieu of contemporary industrial practices.
3. While students have generally accepted dominant social values in the past, today's learner chooses to challenge them. An example would be industry's pursuit of profit at the expense of ecological imbalance, environmental pollution and diminishing natural resources. Teachers have difficulty in accommodating this kind of challenge.
4. Society in general and education in particular have been wont to categorize students according to imposed goals rather than providing a diverse spectrum of information upon which students can base well-informed and meaningful personal choices.
5. For many years teacher education institutions were reticent to take a leadership role in curriculum renewal or to accommodate contemporary thought in their programs. Therefore, many teachers were leaving those institutions ill-prepared for program development at the local level.

Consequently, the articulation process took on additional freight as it gained momentum. The magnitude of the task required that personnel in addition to state staff become involved in developmental activities. Furthermore, funds were needed to buy essential functions pertinent to those activities.

THE KANSAS MODEL FOR INDUSTRIAL EDUCATION

The components of such a continuum are not identified without a great deal of difficulty. At the time these decisions were being made, some research had been conducted

relative to alternatives to conventional industrial arts content. Such alternatives had reached various stages of development, from mere conceptualization to piloted, commercially ready documents. The latter, referred to as the IACP materials, were studied at length and ultimately recommended for adoption as a base for the continuum, with the full realization that content would be taught in various ways to accommodate unique local circumstances.

With that decision as a point of departure, further study was done relative to subsequent curriculum alternatives. It appeared that there was a national trend toward acceptance of three conceptual areas of study: Power and energy, materials and processes and visual communications. Various authors were suggesting other alternatives, some only subtly different and others dramatically divergent in their approach.

DEVELOPMENT ACTIVITIES

In late 1971, two curriculum projects were funded simultaneously, one from ESEA funds and the other from vocational funds. Due to the emergency state of the art and attendant efforts to meet critical curriculum needs of the time, much difficulty was encountered in supervision of developmental activities. In the ESEA project, identified as "Secondary Exploration of Technology" (SET), personnel from three different sized school districts undertook the task of identifying content. An additional focus was to interpret these concepts in light of unique school circumstances such as resources, student enrollment, number of teaching personnel, and others.

The second project, referred to as "Conceptual Base for Industrial Education" (CBIE), involved 45 teachers from the immediate Wichita vicinity in an extensive workshop situation aimed at curriculum development, also for the early secondary level. While the identified concepts were very similar, the philosophical approaches to delivery of instruction were unique to the separate projects.

The common focus on the aforementioned concepts led to their acceptance as second level entities in the state model for industrial education and provided two different sets of documents for local selection. The materials were used extensively in the various project schools and revised extensively. Subsequent to the conclusion of these projects, CBIE and SET, funding was secured for the third level curriculum study. Course materials were developed in the derivative or component areas of the level two concepts with emphasis on specific occupational information. In addition to these documents, special guidelines were developed for "Individualizing Instruction" and "Industrial Studies." Personnel from the two projects joined forces in writing these materials. All materials from the curriculum endeavors are now available for state-wide distribution through the vocational curriculum laboratory at Kansas State College of Pittsburg, along with the level four guides developed through the Mid-America Curriculum Consortium centered in Oklahoma.

PROFESSIONAL DEVELOPMENT

While instructional material needs were being addressed quite adequately through developmental projects and consortium involvement, other program needs became increasingly clear. Colleges and universities in the state were working diligently to provide inservice activities to bring both prospective and practicing teachers up to date regarding contemporary thought in industrial education. However, much difficulty was encountered in arousing interest among teachers who were confused by new titles and concerned about personal inadequacies to manage the new content. A special appeal was submitted for EPDA funds to take the program to the teachers.

A full-time coordinator was employed to organize this special activity, the objectives of which were:

1. To stimulate the teacher to inquire about recent change and growth in industrial education.
2. To rid the teacher of fear of involvement in curriculum renewal.
3. To motivate the teacher to get back to the college classroom to renew his teaching skills.

Industry was approached to provide atypical kinds of equipment to the project for the purpose of demonstrating, for teachers, activities related to the three second-level courses. The equipment was uncommon, in that few teachers in the field had ever had an

opportunity to operate it. These items were loaded into a large, leased fifth-wheel van for transport to 13 host sites to which area personnel were invited. Specialists in the three identified course areas, primarily from teacher education institutions, were brought in to provide special instruction. Participants, including personnel from all four levels, were also given some basic information relative to the state model. Between 250 and 300 teachers were involved in the workshop activities.

A rash of serious injuries in industrial education laboratories yielded evidence of yet another critical need in the field. Funds were subsequently obtained for a concentrated effort to bring about a more acute interest in safety. The classroom teachers are currently being trained in all aspects of laboratory organization to provide direction for the activity. These personnel will then be required to conduct 20 field workshops in their geographical areas. Special emphasis will be given to provisions of the Occupational Safety and Health Act and its presumed impingement on laboratory practices. Performance objectives for the project include a 20 percent growth as indicated by pre-test and post-test comparison. It is also presumed that some measureable attitudinal gains will result from the activity.

Another activity is also currently dealing with the problem of building a certification model consonant with the state model. Discrepancies currently exist relative to professional requirements for the various levels of instruction. An effort has been made to draft a listing of cognitive and psychomotor competencies required to teach the respective levels. The Kansas Industrial Teacher Education Council, comprised of department heads from all state and private institutions with industrial education programs, has assumed much of the responsibility for research and development in this area. The present stalemate in this activity is an obvious indicator of the difficulty in reaching consensus in that critical effort. The major points of discussion have been:

1. Should industrial experience be a requirement for instructors at every level?
2. Would it be appropriate to require teacher preparation courses in levels one through three for trade level teachers?
3. Should all teachers ultimately be required to have a degree?
4. What are the most immediate course needs of the non-degreed trade instructor coming into the classroom?

One would have to agree that the need for solutions to these questions makes the certification process the most pressing issue at this time. Some type of funded activity will ultimately be required to bring interested personnel together in an intensive decision-making session for the purpose of identifying future direction in this area.

FUNDING

The Higher Education Amendments of 1972 very precisely identified industrial arts in vocational education legislation as instruction which might facilitate informed and meaningful career selection on the part of the student. The model for industrial education in Kansas was, subsequently, identified in the State Plan for Vocational Education. All levels of the plan, therefore, are eligible for vocational funds.

The State Plan for Vocational Education, in addition to establishing management policy for distribution of state and federal money, provides for a local tax assessment for vocational education. This has been vital to the expansion and improvement of instruction in Kansas schools. Furthermore, large amounts of state and federal resources have been committed to curriculum work, professional development, and certification study. In spite of all that has been accomplished, much effort must be expended to bring about a general state-wide application of contemporary program concepts. Limited personnel resources have somewhat hampered a more rapid implementation of approved guidelines.

CONCLUSION

The advantages of an articulated program of industrial education effort are innumerable. Assistance for industrial arts at the local level was formerly handled by one person. The Trade and Industrial Education Section was staffed with two positions. The merger and subsequent acquisition of an additional position provided a four-member staff serving multi-level functions. This contributed to early rapid growth of the industrial education

concept in the state. Present economic and political constraints have forced temporary curtailment of some of the activities. However, the program appears viable and, pending removal of imposed personnel restrictions, should continue to grow.

Further information can be obtained by writing:

Ed Henry, Program Administrator
State Department of Education
120 East Tenth Street
Topeka, Kansas 66612

Mr. Foth, State Department of Education, Topeka, Kansas.

Technical Education in Nonpublic Schools

Jeffrey L. Kleinbeck

Dr. Grant Venn, in an address to the United States Office of Education, stated, "The more complex a society becomes because of applied technology, the more dangerous it can be for its members. The use of advanced machinery, automobiles and aircraft place our lives in the hands of the people who designed and built the machines and in the hands of those who maintain, repair and operate them. Thus, the general well being and attitudes of our population are becoming increasingly dependent upon the teachers of technicians and engineers."

Current employment trends show that jobs today are in the fields of engineering and technology. A recent study taken by the College Placement Council showed that based on a central group of 159 colleges, 102 percent more jobs were offered in engineering or technology than in the liberal arts fields. The figures were taken from college level disciplines. We shall consider how this fact affects the potential of technical training in the nonpublic school systems.

I believe that programs in technical education would benefit your students, your school and your community. I will also discuss several practical aspects of how such a program can be worked efficiently, practically and economically as an integral complement to your present curricula.

In order to examine how we can benefit our students, we must first define the various groups of students with whom we will be working. Statistics show that 29 percent of the graduating seniors in 1976 will not seek any further education beyond high school. Out of the remaining 71 percent who will continue their education, approximately 55 percent will attend junior college for vocational or technical training. Only 45 percent of this year's graduating class plan to continue for their bachelors degrees. Granted, some students, after their education in a junior college, will transfer for a bachelors degree. But the fact remains that you will have representatives from each of these groups in your schools. How can we establish a curriculum in technical education to satisfy the demands of each of these individual groups? Such a curriculum should carry with it a four-fold purpose. That is: A vocational purpose, the general educational purpose, a motivational purpose, and a subject very near and dear to all of us today, an economic purpose.

First of all, the vocational purpose. I am not saying that the nonpublic schools interested in technical training should try to establish a vocational training program. The vocational aspect of technical education would apply best to that 29 percent group that has no intention of continuing education beyond high school. With a general knowledge of technology, they could proceed into the blue collar circles with at least some knowledge of manufacturing processes and sufficient practice in their execution to develop skillful and efficient production. Such a program can be established with the use of instruction in mechanical drawing, internal combustion engines and basic repair procedures, welding, machine tool or wood shop experiences.

Secondly, the general education purpose of technical training is probably the most practical of the rationales for a technical program. This would benefit all of the student

groups. An emphasis is placed on the study and value of materials, processes and conditions of production, wise purchasing and care of materials. There is one very important aspect which all too often is disregarded in a student's technical training — the business aspects of technology. In the establishment of sound technical programs to complement the other school programs, one should always bear in mind that the students of today need to learn the wise use of money and materials. Projects should be constructed to cause the students to research the cost of materials and cost of labor if such a project was to be built by an industrial firm. In some cases, this can be achieved by creating a hypothetical situation in which you, the instructor, are a customer, and you want an estimate of how much it is going to cost to build a certain project. Then allow the student to build the project, emphasizing the importance of wise use of time because of the cost of labor. The general education purpose of technical education is the most valuable argument for the establishment of such a program.

A program in technical education adds much to a school's curriculum in its motivational value. The average student today is just not excited about the standard classroom experience; he can see very little individual creative value coming out of the classroom. When a student is given a chance to build something with his own hands and learn from it, that student gains a great deal of satisfaction. Thus, the student in many cases is assured of the fact that he is of some value in this world and does have a contribution to make to our modern technological society. Even the more academic subjects such as mathematics, physics, science, history and English become more interesting when applied in technical education.

A problem that faces the non-public schools more than our public schools is obviously economics. I have already mentioned the economic education a student would gain in a well-rounded technical education. Bu let us now examine the economic value of such a program to our schools and how such a program could be economically justified. A curriculum in technical education would provide a source of design and construction for needed material within the school. By allowing the students to design and construct needed equipment or facilities within the school, one would be creating a sense of pride in the student's work, as well as providing an inexpensive source of construction for this equipment.

Technical curriculum funding can also be aided by sale of constructed materials such as small storage houses, welded items and various other projects. Money brought in from these would be re-invested into the program to purchase more materials. A student-supported program is a very effective means of rationalizing your technical programs. The students should be required to supply their own tools and materials for their projects. A fee can also be assessed for laboratory work to help support the purchase of hand tools supplied by the school.

Many of your schools are supported by church constituencies. By presenting your need for materials for your program, you would be giving people outside of your school a chance to participate by personal donations. Military surplus also offers a very inexpensive source of needed equipment.

I have recently discovered a program which could be utilized in the establishment of a technical background for the students of our non-public schools. This is known as distributive education. The program is utilized by juniors and seniors in high school. The purpose is to provide practical experience training on the job and a practical application of the academic courses to the business world. This program requires the cooperation of several local businessmen willing to work with the students in their respective businesses to provide this on-the-job training. The students will attend the regular classes for one half day and work on the job in the second half. The student is placed in a job which is relative to his or her vocational interests. It allows the student to see his technical training as well as his academic training in action. The sponsoring businessman will pay the student for work. This type of program will replace the cost to the school for training a student. We must also consider the public relations aspect of such a program. The distributive education program would allow the opportunity to take the ministry of your own schools and share them with local businessmen. This would also encourage private donations to the school and its programs.

Let me share one bit of educational philosophy with you from LeTourneau College. We at LeTourneau have a three-fold approach to education: The academic, the practical, and the spiritual. The academic is the basis of all forms of education. The classroom experience provides the fundamental cornerstones on which we can build. But without a

practical application of all academic areas to everyday circumstances, the education we offer is incomplete. To take the academic and the practical and surround these with a very positive spiritual atmosphere is to provide that third dimension to our educational programs. By applying the spiritual aspect to the classroom and laboratory experience, we can make a practical application of Christian principles to everyday life. These three objectives — academic, practical and spiritual — are especially effective in technical education.

Our non-public school systems have a very important ministry to perform in these days of weakening public educational systems. We as non-public schools must recognize the need for technical education for our students so that we may provide a top rate, well-rounded education for our non-public school students.

Mr. Kleinbeck is Admissions Counselor at LeTourneau College, Longview, Tex.

A Study of Ninth Grade Curricula in Industrial Arts for Three Groups of Selected Nonpublic Schools

Gerald B. Laverman

With the ever-increasing growth of technology as a major force in modern society, industrial arts education has gained greater attention as an important element in the education of our youth. In recent years there has been considerable alteration in the structure and process of this subject area. Various curriculum plans have been proposed by leaders in the field of industrial arts as alternates to the traditional approach still widely practiced.

It would seem, however, that among non-public schools there has been a lack of familiarity with new curricular developments in this field and a definite need for research and local innovation. Three groups of such non-public secondary schools were selected for this study:

The Lutheran Secondary Schools–Missouri Synod
The National Association of Christian Schools
The National Union of Christian Schools

It was felt that while there are differences in philosophy, objectives, and organization, there would be enough common ground to foster some cooperative curriculum development. Providing basic information and guidelines for those who become involved in the planning of new curricula for industrial arts in these schools was the over-all purpose for this study.

The specific problem studied in this research was: What are some appropriate curricular designs for ninth grade industrial arts education in three groups of selected non-public schools having some similar characteristics? In order to gather information and data relating to this problem, the following procedure was carried out:

First, a careful review was made of a variety of different types of literature dealing with the general area of the problem and concentrating on the particular topics of the junior high school and its students.

Second, a mail survey was conducted involving all schools within the three selected groups which had a ninth grade. This survey was designed to provide data concerning (a) the basic characteristics of the school related to curriculum development, (b) the nature of any industrial arrs program which may have been available at the school, and (c) the preferences of industrial arts teachers as to the type of program which they would deem most desirable for their school. For items (a) and (b), a two-part questionnaire was mailed to each school. The preferences in item (c) were determined through the use a Q-Sort technique in which 50 curriculum statements were arranged by industrial arts teachers according to a prearranged frequency distribution.

There were four major outcomes to the study.

1. After reviewing all materials used in the literature survey and analyzing all data from the mail survey, the following alternative solutions to the problem were arrived at and discussed: (a) handcraft activities related to regular subject areas, (b) club programs, (c) mini-courses, (d) department within the school, (e) shared time program with a local public school, (f) limited classroom, (g) comprehensive classroom, (h) special laboratory, (i) mobile laboratory, (j) centralized laboratory, (k) traveling teacher, (l) resource units, and (m) contemporary curriculum projects.

2. A list of 20 guidelines was assembled for use in curriculum development projects. These should prove helpful to teachers, administrators, curriculum specialists and curriculum committees within the three groups of schools in the study.

3. Six criteria for evaluating any newly proposed curricular approaches were identified and discussed.

4. A guide to curriculum materials for industrial arts in grades 7 through 12 was compiled and included in the report.

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Humanistic Technology—A New Horizon for Industrial Education

T. Norman Tomazic

Nearly 200 years ago our forefathers initiated the action that led to the foundation of our country. The action took the form of a political revolution that was unique in the history of man. It was not a revolution born in the angry frustration of a thrown brick, and it was not a revolution of an uneducated oppressed rabble. The American revolution was the product of considerable discussion and argument by well educated gentlemen, and the declaration that provided the framework for the rebellion was the result of a thorough analysis of the rights of man and of the desire to preserve those rights for any persons who wished to join together in the new republic.

The point that is relevant here is that careful analysis preceded worthwhile action—a melding of careful thought with purposeful action permits advances in all of man's institutions. In the educational institution, action has not always been seen as a desirable component of the process of educating youth. Since the time of Comenius[1] and throughout the years since, there has been an echoing call for a meld between thought and action in the schools. In recent years, the public schools have been called a "wasteland" for the simple reason that worthwhile action has, by and large, been left out of the curriculum.

Our profession has attempted, through the years, to provide a link between thought and action, but we have had varying degrees of success in the venture. In a frantic attempt to get action into the curriculum, we have, at times, left thought out instead. We often find ourselves behaving according to our individual interpretations of what the title of our program implies. Manual training—manual arts—industrial arts—industrial technology—technology education—these changing titles should suggest some sort of growth or evolution, but many of the activities that take place under the title of technology education are identical with those which were formerly found under the title of manual training.

Manual training, as a title, does not imply a meld of thought and action, but technology education certainly should. In recent years, more and more members of our profession have come to agree that we should focus our attention upon the study of technology. But there is little evidence of consensus for a definition of that term.

Technology has *been* defined as "the science of efficient action,"[2] but there is a problem with that definition—the question is, "What is efficient?" All too often we have measured the efficiency of our technology by purely economic yardsticks, and we have neglected any consideration of human efficiency or ecological efficiency. As a result, we

are faced with an inadequate curriculum in a technological society that is slowly becoming aware of the human and ecological inefficiencies which threaten the survival of the society.

As a profession we are responsible for our curricular inadequacies -- and perhaps, to an extent, we are responsible for the technological inefficiencies that we are now recognizing as equivalent to technological failures.[3] If the general public has been unaware of the faults of the technological system, then technology education has also, in that respect, been a failure.

At our Louisville convention in 1970, Dr. Maley asked that we look at "both sides of the coin"[4] in our industrial education programs -- but it is difficult to address the problems of technology in a social setting when our curriculum consists of woods, metals and drawing education rather *than technology* education. We still have not addressed our own curricular inadequacies, let alone the problems of our technological system.

How long can we go on with our own version of the "sabre toothed curriculum?" As long as we continue to justify the production of pump handle lamps, breadboards and center punches on the grounds that they are worthwhile "practical" exercises, we will not have addressed the concepts of technology in any meaningful way, and our students will not have had the opportunity to analyze our technology, to comprehend its complexity, or to detect its faults. There is simply no more reason to tolerate some of our individually hand-crafted projects as a viable study of industry than there would be for accepting sabre toothed tiger scaring, wooley horse clubbing, or fish grabbing as worthwhile components of public general education.

Our industrial education must focus on technology, on how technology impacts upon us, and on how we can control its growth and direction. The activity that we advocate should be a product of such an analysis, and should neither be neglected as an expensive frill nor aborted into some "canned" project which is expedient or deemed worthwhile because it contains all the operations required for skill training.

Technology is a pervasive part of man's existence, and it should be included in the general education of all persons. Technology does impact upon man, and we, as technical educators, have the responsibility of directing our students toward inquiry into that impact. Technology is controllable by man, and it is our responsibility to see that all students understand the nature of technology and the means by which it changes and develops in magnitude.

Students must examine technology to determine what it has done and can do for man and to man. The environmental effects of technology have gained considerable attention in recent years, but our industrial curricula have hardly scratched the surface in analyses of such effects. The automobile and power generation plants are significant polluters, but students should also be aware that earlier transportation technology -- horsepower -- was not without its detrimental effects; a southern city recently attempted to correct the problem with legislation requiring horse diapers. Knowing that power plants cause air pollution is one thing, but students should also know that the alternative of a hundred million primitive cookfires would cause far worse pollution. Air pollution in pre-electrified London was far worse than it is today.[5] Students should be aware that our technology, though imperfect, is not always a villain in man's society.

All of man's institutions are affected by technology both positively and negatively. The family unit in high technology countries is smaller, less prone to sickness and disease, more mobile, and less cohesive than families in low technology countries. Television has altered family interactions, transportation has spread families to the limits of the continent and rapidly changing occupations have created a less secure homelife for millions of high technology families. On the positive side, the work of maintaining a comfortable home, preparing meals, washing dishes and clothing and other family maintenance activities has been considerably relieved by technology. The technology of birth control has relieved many families from the fear of unwanted pregnancy. The recreational possibilities open to high technology families are virtually endless.

The rapid growth of technology has created severe problems for our educational institutions. The problem of keeping up with current developments is virtually insurmountable. It has been estimated that to keep up with current literature in even a narrow field of technology such as electronics, a person would have to read for 140 hours every week.[6] The explosion of knowledge is making continuing education mandatory for all professionals and technical workers, and highly desirable for the general population who must make educated decisions regarding the implementation of innovative technologies.

And yet, in spite of a dire need for updated programs and totally new programs, the sabre toothed curriculum is more evident now than it was in 1939 when Dr. Benjamin introduced his satire on the dilemma of a virtually changeless institution in a rapidly changing society.[7]

Many industrial educators are still placing considerable emphasis on basic hand tools while virtually ignoring numerically controlled tools, computerized industrial robots, and other new technologies — and yet we profess to be interpreting industry to our students. Current technology should have a much greater share of the structure and content of industrial education.

The effect of high technology on the institution of government is difficult to assess. Our recent experience with Watergate[8] and the CIA disclosures[9] have revealed the problems that can arise when new technologies are used without regard for contemporary ethical standards. Many Americans have expressed a loss of faith in government — but the problems of internal espionage and invasion of privacy are as nothing when compared to global issues of governmental policy related to nuclear weapons, energy resources, food resources and the continual presence of so-called "small-scale" wars. Innovative technologies may be expected to change governmental policy in all of these areas and more. New technology can not only change our relations with other world powers, but can drastically alter what we have come to know as the American life style.[10]

Serious questions have been raised regarding the advisability of continuing to implement higher and higher technology in American industry when increasing numbers of unemployed seem to be the inevitable result. We are faced with the possibility that a mere 8 to 15 percent of the population will soon be able to provide all the goods and services needed by the remainder of the population — and we have not yet determined how the unemployed portion of the population will "earn the right to live."[11]

The new technology not only has the power of taking away man's livelihood, but may also threaten his very existence in a number of ways. The increase in pollution of all types, noise, air, water, solid waste and others, poses a constant threat to deafen, suffocate, poison and eventually bury mankind with the unforeseen side effects of advanced technology.

Some authorities suggest that advanced technology is destroying religious belief. Others suggest that the Judeo-Christian beliefs are the foundation of modern technology, a manifestation of the charge to "go forth and dominate."[12] Pierre Teilhard de Chardin has suggested that technology has given man the ability to reflect upon his own existence and has thus provided an atmosphere where humanity can become more human — where man can concern himself with his fellow man and not merely with his own survival in a hostile environment.[13]

Perhaps man's first step on the surface of the moon caused some earthlings to begin to doubt religious dogma that seemed threatened by that event, but for the astronauts who made the lunar journey, the feelings of insignificance in an awesome universe seem to have caused them to view their life goals differently, and they have found a new dedication of service to their fellow man.[14]

There seems to be little reason to doubt that man's technology has had a profound impact on his existence, institutions and future. Technology affects man's values with, perhaps, greater force than man's values affect technology. The future of man seems dependent upon how he will support future technological innovations and on how quickly he will be able to identify and eliminate the negative consequences of all of his technologies, both current and yet to come.

The kind of person who might be able to understand and control our technological future will not be the person who sees technology as the squaring of boards or the manufacturing of sheetmetal letterholders. A broader understanding of man's technological heritage and potential is needed. I would propose a philosophy that might encourage such a broader understanding of nature, technology and interactions between nature and technology.

HUMANISTIC TECHNOLOGY — A NARRATIVE DEFINITION

Industrial education has been devoted to the perpetuation and advancement of the technological ethic, an ethic which has been dominated by economic interests and objectives. Yet it is apparent that technology has far more than an economic impact upon man's existence, and it seems incumbent upon industrial education to ensure the dissemi-

nation of knowledge regarding the full impact of industrial technology on man without an overwhelming emphasis on the purely economic impact of such technology or upon the preservation of a concept of unrestricted technological growth that seems to have been, and may continue to be, detrimental to the survival of man as a species. Some form of value education that transcends the occupational-career-consumer values that are currently so much a part of industrial education must be interjected into technology education. Every effort must be exerted to make students aware of the processes of technology assessment that reveal the possible, probable, and improbable short-term and long-term effects of our technological heritage and of our technological innovations.

At the same time, however, technical educators cannot espouse a complete stagnation of technical innovation or exploration. Research and development efforts should be encouraged toward those ends which would fulfill the promise of a technologically humane society where individuality is neither sacrificed for economic considerations nor subjugated to governmental control for dubious social-organizational ends.

Knowledge, action, and evaluation seem to be intricately related. Action without knowledge is usually aimless and purposeless. Knowledge without action is useless and wasted. Action without evaluation would be pointless. Valued action based on knowledge is what man's technology should be all about. We value action for many reasons — selfish pleasure, service to others, satisfied curiosity, creative accomplishment and personal health are but a few of the values that we might apply to our actions. But our values may be in conflict with the values of others, and our actions may create problems of serious consequence.

With modern technology, the action of an individual has become increasingly important to the collective society. It is now conceivable that one man could destroy the world at the push of a button. The establishment of a manufacturing plant can affect a local region in a disastrous way or may have a more insidious effect on the whole ecosystem. The distribution of consumer goods for unrestricted use can create enormous social, environmental, and personal-ethical problems.

There seems to be a close association between man's techniques and his purpose for existing. Man has experimented with techniques — ways of doing things — since the dawn of his presence on earth. In spite of some very serious consequences of some of those techniques, the human condition — the ability for man to reflect on being, the ability to empathize with others who may be continents away from his immediate environment — has been advanced by ever more efficient techniques. Aside from the economic aspects of the technological phenomenon, mankind is infinitely more humane now than prehistoric man could have been. Certainly man is still capable of doing great harm to his fellow man, but new technologies have lessened the outright cruelties that history tells us were common in our recent past. Weapons are less important now; men are negotiating with words instead of clubs, and a new awareness of the world society is slowly making inroads on policies of local, regional, and national governments.

It is incumbent upon man to foresee the limits that he must place on the use of technology, to envision the kind of "keep off the environment" restrictions that will be needed to keep man from ruining the ecosystem of the future in the same way that he was kept from ruining the lawns of the past. The finite resources of the earth and the relative inflexibility of the ecosystem to recover from technological incursions has placed severe demands on responsible citizens to limit and control technological growth.

Some of the demands can be dealt with by educating the general public to the nature of the problems and/or by legislating for or dictating the means for resolving the problems. Some of the demands can be dealt with through educative and legislative means only if the nature of the demand allows the luxury of such avenues to resolution of the problems. When the demand is critical and requires dictatory action, the educative function is even more critical to prevent the population from rebelling at the sudden restrictiveness of technological controls. Many freedoms now enjoyed by citizens of technological societies will, of necessity, be foregone as legislative or dictatorial action limits the use of our technological capabilities. Former President Nixon's imposition of a nationwide 55 mph speed limit in 1974 is an example of the kind of action that might be expected to become common to control our uses of technology.

We are now in a period of great future orientation; many industries and government agencies spend considerable amounts of time and energy in forecasting possible futures. We cannot ignore the potential of such forecasting activity for industrial education. We must educate future citizens to cope with future eventualities in the technological domain.

By casting many scenarios and exploring appropriate avenues to action and reaction, industrial education can become as dynamic as the technological society in which it operates.

The scenario is not a prediction; it is a speculation about possible future eventualities. The scenario is more in the nature of a fire drill; we do not plan to have our buildings burn, but we feel that it would be foolhardy not to prepare for the possible eventuality that they might. Thus the fire drill scenario is not a prediction, but a form of education that will permit effective and efficient action should that projected future become a reality.

Educational theorists have long held that education should be centered upon problems of youth, on social issues – and should use the content of the academic disciplines as they become relevant to the issues of problems being studied. Approaches such as core, common learnings and the open classroom all reflect the above philosophical position. Problems with the implementation of such approaches frequently center around the student's lack of ability to draw upon those disciplines that would be most helpful in solving the problem at hand. Students need some basic understanding of the structure of the various disciplines before they can ask appropriate questions related to the problem, questions that may be answered by drawing upon the content of the various disciplines.

In the realm of technology education, students must be brought to appreciate the practical application of knowledge toward human ends. They must learn that the action that is initiated to satisfy human needs must be action that also preserves the dignity of man and the integrity of the environment. Any action that is not merely spastic or reflexive must be preceded by thought. Our industrial education programs must ensure that students understand that appropriate technological action is preceded by intensive thought concerning human and ecological consequences. Students must be brought to the position where they put themselves into the technological equation – where they see the personal impact of each proposed technological innovation, and where they can extrapolate such understandings to the whole of society and to the environment as well.

There is some evidence that children do not now see a role for themselves in the technological future.[15] Toffler[16] cites such a condition as conducive to future shock. It seems that we must emphasize learning experiences in technical or industrial education that involve the student with present and future technological reality. We must do this by engaging in technology assessment, through student speculation about the future, through activities that reflect a value orientation that places mankind above the machine, through a humanized delivery system that enables the student to explore his values and feelings about the use of technology and through an emphasis on humane technology throughout the instructional program.

There does seem to be a "technological imperative" that dictates action in many spheres of human life. All too frequently we find technological man doing what can be done rather than considering what should be done. We seem to need a human commitment for our technological effort; we need an environment that is designed for man's purposes, self motivation, discipline, fulfillment of man's primary goals and with economic growth and profit as by-products.

Calling for less emphasis on profits and economic interests may seem like heresy to the industrialist, but the educational institution should not be the servant of industry; it should be the servant of man. Our educational philosophy should call for a general understanding of the tremendous changes that technology has wrought for society and must emphasize the choices that society must face as a result of technological development. The philosophy is one that constantly poses the question, "How shall man use his technological knowledge and powers?"

The philosophical position's metaphysical assertion is simply that man exists independent of reason, but his existence is threatened unless his reason is brought to bear on his existence. Its epistemological assertion suggests that man's knowledge grows out of his experiences and upon his introspection related to his experiences. The axiological dimension of the philosophy suggests that man's values grow out of his actions. Those actions that give pleasure and satisfaction are valued over other actions which fail to give satisfaction. Values are further affected by socialization. Those actions which are favorable to the society are valued over those which are detrimental to the society. And knowledge is valued as it aids in the humanization of man.

The humanistic technology philosophy makes man responsible for himself and for what he becomes as a result of his free choice in all matters regarding action. It

recognizes the pragmatic value of advanced technology, as opposed to man living in a more natural low technology harmony with the ecosystem, but cautions against the danger of man's repeated disregard for the impact of his actions upon the environment and upon his fellow man.

ASSUMPTIONS FOR THE DEFINITION

The development of the operational definition of the humanistic technology philosophy proceeded under the following assumptions.

1) The world of the future will be one in which changes will occur at an ever-accelerating pace. These changes will continue to generate conflict for man.

2) The world of the future will see a rapid and fundamental change in the accepted norm for humans living in society.

3) There will be profound developments in science and technology, with an increased emphasis on research and the continued expansion of human knowledge through improved information storage and retrieval capacities.

4) There will be increasing concern for human welfare, using the achievements of science and technology for the benefit of mankind.

5) There will be an increased use made of automated and cybernated devices, processes and computers that will change the nature of man's occupational endeavors, the relationship between work and leisure, and the individual's ability to achieve self-fulfillment.

6) There will be greater emphasis placed on leisure time pursuits, travel, education, arts, crafts and other creative activities.

7) Man's life span will be lengthened, thus creating a need for continuing education and a periodic reestablishment of life goals.

8) A large portion of our reality is by definition technological, and man is not sufficiently aware of the impact of that reality upon his values and his existence.

9) All citizens must have an understanding of our industrial-technical system.

10) The future of industrial arts in the public schools may center upon the installation of curricula designed to provide citizens with an understanding of industrial technology and its effects on man and the environment.

11) One must evolve from a condition of stability into an unstable state, and then to a new stable state in a continuing cyclic process in order to advance one's position.

12) Mankind has never lived in such an unstable state as he does at the present, and the social conditions that result from that environment are full of anxiety and unrest.

13) Even though individuals can assert themselves in more ways now than ever before in history, they must face the threats that the new individuality poses because of the advanced technology of our age.

14) Although individual powers have been advanced beyond what most men have ever believed possible, many individuals are gripped by an almost overwhelming feeling of powerlessness to affect any meaningful changes over the human condition.

In the days of our primitive ancestors, the young man who failed to learn the techniques of survival — hunting, firemaking and cultivating crops — simply did not survive. In more recent years, a young man needed to learn certain computational and language skills to obtain employment that became his life's work and thus his means of survival. In the future, and to a large extent in the present, the skill most needed for survival is the skill of quick adaptation to technological change. The nature of technological growth is such that future breakthroughs will be astounding and virtually devastating to any who fail to keep up with the steady progress of technological innovation.

The need for an emphasis on humanistic technology is important from the standpoint of societal needs as well as those of the individual as outlined above. A curriculum that centers on humanistic technology should provide a balance that will close the gap between the technologist and the humanist.

The humanistic technology philosophy suggests that reality has natural and man-made dimensions. The natural dimension of reality includes all the substances and systems of the universe, including man and other living creatures. The man-made dimension of reality includes all the abstractions and synthetic combinations of natural reality that man has devised through centuries of efforts to attain valued ends. The most important tenet of the humanistic technology philosophy is that man exists as a part of, and not apart from, the natural world. As a part of natural reality, any action of man affects

nature; man's techniques for survival, inquiry, industry, pursuit of pleasure and social organization have a direct impact on the substance and systems of the natural world. The value orientation of the humanistic technology philosophy places concern for the survival of man as a species moving toward an unknown Omega of higher development as the primary guidepost of human action. The mantle of that primary value includes the values of preservation of human life, human dignity and human welfare along with promotion of the human intellect and physical condition through processes of inquiry, industry and creative thought.

AN OPERATIONAL DEFINITION OF HUMANISTIC TECHNOLOGY

The statements which follow describe a technical educator who holds the humanistic technology philosophy.

1) The teacher will establish educational goals that will aid students to analyze the relationship between the natural and man-made world to demonstrate the impact of technology on the environment.

2) The teacher will expect students to analyze the relationship between the natural and man-made world to determine appropriate directions for technological growth.

3) The teacher will devise and/or implement educational experiences that enable the student to predict outcomes of actions within the realm of industrial technology.

4) The teacher will devise and/or implement educational experiences that will aid the student to reach a sense of self-fulfillment regarding his use of industrial technology and his control over industrial technology.

5) The teacher will establish learning conditions that permit students to demonstrate their learning through activities designed to synthesize acquired knowledge through the development of concrete and abstract problem solutions.

6) The teacher will establish learning conditions that permit students to apply their values to the development of technological scenarios for the future.

7) The teacher will establish learning conditions that permit students to analyze their future scenarios to determine possible problems for man and the environment.

8) The teacher analyzes instructional materials to determine the extent to which positive reinforcement of concepts regarding the humane use of controlled technology is presented.

9) The teacher will serve as a resource person as students attempt to synthesize their learning of the natural and man-made world through the development of solutions to man's technological problems.

10) The teacher will examine the students on their ability to analyze man's present technology to determine the effects of that technology on man and the ecosystem.

APPLYING HUMANISTIC TECHNOLOGY TO AN INSTRUCTIONAL PROGRAM

1) Instructional Goals

a) To help individuals learn the structure of the man-made world and the relation of that structure to the natural world.

b) To enable students to experiment with proposed solutions to human problems which draw on man's technological knowledge.

c) To enable individuals to research, design, and produce improvements for past technologies and to propose innovative technologies that serve and benefit man.

d) To enable individuals to identify themselves as responsible for the growth of our technological system and for the outcomes of that system.

e) To enable individuals to plan for possible futures, to anticipate probable futures and to work toward preferable futures for man's technology.

2) Course content

Under this philosophical outlook, students would study man's technology — manufacturing, construction, transportation, communication, etc. — and will focus on current tools, methods and materials while exploring probable future directions. Study will include the effects of technology on man, society, man's values and man's environment. A close examination will be made of the values that control technology.

3) Activities

a) Concept acquisition activities will include simulations of industrial R & D, mass production and sales promotion.

b) Technology assessment will be engaged in to research the consequences of past technologies and proposed future technologies.

c) Scenario building will be used to develop possible, probable and, especially, preferable futures.

d) Students will redesign problem technologies – i.e., alternate energy devices.

e) Students will study local problems related to technology; photographic records, interviews and surveys could be used.

f) Students will suggest changes in local technologies that would improve the environment of the community or that would improve the local society in some way. Then students would work toward accomplishing those changes through public education, legislative lobby work or personal action.

CONCLUSION

The humanistic technology philosophy as defined above may have a social studies sound to some industrial educators, but in most of the classic definitions of industrial arts there is some reference to the human and social consequences of industrial activity. The humanistic technology philosophy has been proposed to make our programs of industrial education align themselves more closely with our definitions. We can direct our students into actions which will help them understand their responsibility in managing our technological future. We will spend the rest of our lives in that future.

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Elementary School Industrial Arts

Industrial Arts Resource Kits for K-6 Grades

Harold G. Gilbert

The 23rd Yearbook of the American Council on Industrial Arts Teacher Education is entitled "Industrial Arts for the Elementary School." It has chapters that define a program of industrial arts in the elementary school and describes the child, the technology, a curriculum, contemporary programs, environmental designs and personnel. It also suggests possible teacher education programs, philosophical positions, research, and gives a historical reflection.

The purpose of this presentation is not to describe a complete program as the yearbook does, but to suggest one approach to developing a program.

In the past many schools have used a full-time industrial arts consultant to teach units of study and provide materials and suggestions for classroom teachers. The consultant sometimes served several schools in a district. With shrinking budgets and inflationary costs, many schools have had to eliminate the full-time industrial arts consultant.

Some schools have replaced the consultant with a classroom teacher who has special ability to serve as a resource person to other teachers. The preparation of teachers with this special ability may take place in undergraduate classes, graduate classes, or in teacher workshops or institutes. The latter may be organized by middle or high school industrial arts teachers.

Teachers in K-6 classrooms have used resource kits for some time. In science the school can purchase a kit for studying magnetism, animals, or leverage. In language arts a wide variety of word games and puppet construction kits are available. For arithmetic skills the teacher may choose from a number of counting devices. In social studies various resource units on regions around home and abroad may be purchased. For industrial arts activities a papermaking kit provided by the Hammermill Paper Company and a kit to make flashlight batteries from Burgess Battery Company have been used for many years.

Some schools are developing a comprehensive career education program in K-6 grades. Industrial arts can make a vital contribution to the technological aspects of this program with units in manufacturing, transportation, construction and communications. Many elementary teachers do not have the time or ability to develop these units, but would welcome a resource kit. With the latter, a few hours of preparation would enable the teachers to provide hands-on experiences in the world of work.

An effective resource kit for industrial arts activities should have about eight characteristics to be effective:

1. Simple activities. The industrial arts activities should involve basic processes of technology, but be simplified for teachers who have not had technical experience. Many classroom teachers have not had an industrial arts course nor worked with tools and materials. The directions for the activity should be written in a language that a classroom teacher can follow to experiment in preparation for the children's activities. For example, in commercial screen printing a lacquer base stencil and oil base paints are commonly used. To simplify this process for children, they can cut a stencil from waxed paper and use finger paints. With these materials they can follow the basic process of screen printing. The simplified activity does not follow the industrial process accurately because of the substitute materials, but does provide a start that the classroom teacher can use to illustrate the process.

2. "Hands-on" activities. The main feature of industrial arts activities for children is to provide the tools and materials for them to try the industrial processes. First-hand

experience will motivate the children to seek information about the tools, materials and processes they are using. For example, they can learn about the flexibility and durability of cowhide by making and using a belt, about the force of atmospheric pressure as they vacuum form plastic.

3. Include tools and materials needed. A classroom teacher needs to prepare several lessons each day, so it is difficult to find time to gather the proper tools and materials. Also the teacher usually lacks the experience to choose tools and materials best suited to the needs of children in the classroom. A resource kit that contains all the proper tools and materials will overcome both of these difficulties. Some articles such as pencils, paper, scissors and glue are found in most classrooms, but any other tools or materials not normally found should be included in the kit.

4. Suggested correlation. The teacher and the children can easily follow directions and make something. Often the children are motivated sufficiently and uninhibited enough to complete the work on their own. However, that is not enough to make a complete industrial arts learning experience which would make a significant contribution to career education. The kit should include suggestions to inspire the teacher to broaden it beyond just making something. For example, the leather kit suggests tanning leather to relate to science and a leather belt production line to relate to social studies. This enrichment helps to justify the time that is necessary to include activity work in a classroom schedule that is already full of worthwhile learning experiences. The combination of areas utilizes the natural motivation provided by industrial arts activities. The classroom teacher needs general suggestions to plan the specific correlation needed by the children.

5. Inexpensive. Increasing costs of education are making teachers more selective in the purchase of resource material. Therefore, the cost of industrial arts resource kits needs to be kept as low as possible to justify the purchase. Tools and materials are more expensive than reading materials, but careful planning and judicious selection can keep the cost to a minimum. For example, in decorating leather, four or five stamping tools are sufficient to decorate leather effectively. It is not essential to have a dozen. The tools in a kit can be shared by several classrooms if the consumable materials are replaced. The initial cost of a kit is usually more than the replenishment of supplies for repeated use.

6. Flexible time. The kit can be designed for a flexible amount of classroom time. Some teachers may want to limit the unit to a day or two until the full learning value is realized. Others may plan a richer, more inclusive experience and have the children take more time. If the basic unit is too long, the teacher may hesitate to try it. However, once the children start the work and the teacher can realize the values attained, there should be suggestions for expansion and continuation.

7. Brief instructions. The teacher's time to try the kit is very limited, so the instructions should be very short but descriptive. If it takes too much time to read the descriptive material, the teacher may set it aside and never return to complete the plans for using it. Once a start is made and the richness of the learning experience is apparent, the teacher may be willing to spend more time in preparing and organizing further classroom work.

8. Include reference material. Pamphlets, pictures and teaching aids for expansion of the unit should be included in the kit. These are usually free material provided by large companies. It should not be necessary for the teacher to take the time to write a letter and wait for the materials to arrive. The kit should be developed so all the resource materials are in the package ready to use.

9. Evaluation. After completion of the unit the teacher and the supervisor should consider the results and plan revisions to make future use more effective. That is also a good time to order materials that were consumed in the learning activity.

There is a danger in providing resource kits that include hands-on industrial arts experiences. They might be used as a toy to entertain the children. A lazy teacher may allow the children to play with the tools and materials and take home an object to please the parents. It takes careful planning and organization on the part of the teacher to make the work experiences meaningful and correlated. If the kit has useful directions and proper resource material, it will be easier for the teacher to incorporate related learning experiences. The supervisor or principal can help the teacher improve the effective use of the resource materials.

For several years the author has experimented with the preparation of resource kits for use in K-6 classrooms. The development started during a discussion with Carson

Thompson of the Tandy Leather Company at the Dallas, Texas, Convention of the American Industrial Arts Association. He conducted a tour of the Tandy factory and suggested points to consider in developing teaching units. Tandy also provided tools and supplies to carrv out experimentation with children in their classrooms. At the end of a full year of experimentation, two kits portraying the leatherworking industry were ready for marketing by Tandy. The first one, Leather — A Useful Material, was a brief introduction to decorating and using leather goods. The children each make two coasters with original designs stamped on them. After using the leather, the children experiment with tanning a rabbit skin and learn more about hides and skins used for articles like gloves and shoes.

The second kit, Manufacture of Leather Goods, attempts to show the children how leather goods are produced in a factory. The children design a leather belt and organize a production and assembly line to make a belt for each one in the classroom. As a follow-up the children study career opportunities in the leather goods industry.

Both of these kits are available for schools to purchase from the Tandy Leather Company. Their area managers provide free demonstrations of the leatherworking processes.

The author has also developed a kit to illustrate the screen printing process. It simplifies screen printing by using waxed paper as a stencil and water-soluble inks like finger paint. It has been thoroughly tested in the classroom, but no supplier has been willing to market it.

Industrial arts teachers and teacher educators may participate in the development of more kits. There is considerable work involved to organize a resource kit, prepare the resource material and test it in the classroom. However, if a number of teachers each prepared one kit and then shared the use of it through the American Industrial Arts Association or the American Council for Elementary School Industrial Arts, considerable progress could be made rapidly.

If industrial arts kits have not been used in a school, it may be necessary to introduce the idea and make some suggestions for using the kits. This may take place at a K-6 teacher workshop, an industrial arts teachers meeting, or in a teacher education program. It would be ideal to have teachers observe children at work with an industrial arts resource kit. If this is not possible, a movie such as the one developed by the author might be used.

The 16 mm color sound film, "I Ma[illegible] It Myself," describes resource units for industrial arts activities in K-6 grades. [illegible]ese units can be purchased as a learning package with tools, materials and complete directions for a classroom teacher to follow.

Groups of children are photographed operating a mass production line for leather belts, assembling a dry cell to power a flashlight, completing a model house, making paper from pulp and screen printing. The narrator describes how these industrial arts activities enrich classroom learnings and correlate with other subjects, as well as being economical of teacher time for preparation.

The last part of the film portrays seven steps a classroom teacher needs to follow in selecting an industrial arts kit, procuring it and using it as an effective learning activity.

The script for the film was prepared by Dr. Harold Gilbert of the Department of Industry and Technology at Northern Illinois University. It was edited by Dr. D. Eugene Meyer of the Department of Education at Northern Illinois University. The production was under the direction of the Communications Services Division, using children from the local school district. A grant from the Tandy Leather Company made it possible to purchase production materials.

To procure the film for use, contact:

Media Distribution Communication Services Northern Illinois University DeKalb, Illinois 60115	Purchase cost $195.00 Rental $6.60 and return postage 16 mm round, color Length: 16 minutes Film #5050627 Free preview w/intent to purchase

Industrial arts teachers might use the movie to help the teachers in their district consider using resource kits for industrial arts activities. If the industrial arts teacher wishes to develop a new kit, the movie lists the features that might be included.

Promoting the use of industrial arts resource kits in K-6 grades seems to be one of

the most efficient ways of promoting the development of a program. It can be the start of further efforts to develop a broader, more complete program.

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Chi'dren and Tool Design

Deborah Patterson

Each of us experiences the need to shape and personalize our environment. Designing creative and functional tools helps satisfy this need. Nature does not provide tools, only natural resources and energy. The imagination develops tools to shape and personalize the environment.

Children, like adults, need to personalize their surroundings. From infancy, children investigate the material world. Their interest arises from a desire to control or use things about them. Pleasure in making things happen permeates children's earliest contact with materials. To destroy and construct helps learning properties of things, and in this way children develop concepts of weight, height, size, volume and texture.

The ideas and imagination of children are expressed in the things they build. Primitive materials such as sand, water, clay and wood attract and evoke concentration and inventiveness. Natural and manufactured materials of many shapes, colors and textures stimulate children. Thus children have the ability to turn sticks into wild horses and junk that adults overlook into usable tools and materials.

Children must work with their hands, minds and hearts. It is not enough for them to watch the industrial arts teacher demonstrate how to shape wood, clay or metal with tools. Children need their own equipment, simple and workable.

Much equipment used in an elementary school industrial arts program can be designed and constructed by parents, teachers and children. Classroom-made tools, machines and processes are cheaper than their commercial counterparts. Tools do not have to be purchased to be useful or durable. Tools made by children and teachers can be specialized for the particular needs of a project. For example, if 2-inch holes need to be cut in cardboard, kids can design a tool to cut this size hole.

Tools made in the classroom can reflect a personality and humanness. The tools can feel good and be fun.

When children are involved with tool construction, they better understand the interaction between tools and materials. They become the true shapers and masters of the material.

Here are some suggestions for tools, simple machines and processes that are inexpensive and easily incorporated into an elementary school industrial arts classroom. All of the suggestions can be constructed at school or in a home workshop by either parents, teachers or children. I am not recommending throwing out traditional tools. Children learn a lot hammering and sawing with purchased tools. I am merely suggesting alternatives that can be fun and exciting to try with young children.

SUGGESTIONS

- A wrench can be cut out of wooden stock, either on a jig saw or with a coping saw.
- Bolts are threaded dowel rods 1/2-inch thick. The nuts are 2- by 2-inch squares with the center drilled and threaded.
- Simple shapes can be cut out of wood on the jig saw or saber saw to make screw drivers.
- An x-acto blade can be mounted on a wooden block for easy cutting of holes in cardboard. A nail is used as a center punch.
- Simple hammers are made by drilling blocks of wood and gluing dowel rods into the holes. Different sizes and shapes of hammers can be constructed.

- Wooden nails are made by sharpening a small dowel rod in a regular pencil sharpener.
- Old hacksaw blades can be recycled to make terrific cardboard saws.
- A bow drill is made from a sharpened nail, a dowel rod, a leather strap and a wooden bow.
- Cardboard can be used to construct shelves.
- Cover cardboard with burlap or any fabric to produce a bulletin board.
- A broken hacksaw blade can be inserted into plastic tubing to make a soapstone saw.
- To make eraser presses, draw letters, numbers or designs on large erasers. Carve away the undesired sections.
- Relief prints can be made from any object with a surface texture.
- Clay ribs can be cut from wood, plexiglass or other scrap materials.
- To make a wire trimmer, cut a saw kerf on each end of a 3/8-inch dowel rod. Bend a sturdy wire and insert ends into the kerfs. Wrap the outside with wire.
- To make a needle, drill dowel rod, and glue and insert sewing machine needle.
- Clay dug by students or purchased commercially can be mixed or kneaded by placing it in a tub and stepping in it with bare feet.

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Industrial Arts Activities Center and Metrics

James F. Snyder

Given a list of tools, a list of materials, a series of instructions and a set of slides, the activity center begins to buzz with sound of children working.

The emphasis of our center's activities evolves from the need for learning about metric measurement. Because the cost of metric measuring instruments for the classroom can be very expensive, we have developed metric instruments that are constructed by the children. This activity provides an interdisciplinary flavor to the activity center. The children develop many new skills while constructing the instruments, and later they use these instruments to expand further their knowledge of mathematics.

While the children construct the instruments they use the metric system for measuring parts to be cut, fabricated and calibrated.

Many industrial arts techniques are used in the development of the mathematics instruments. The task require children to saw, hammer and measure at various levels of skill development. Each new instrument requires the use of more new tools. The simplest instrument requires the child merely to silkscreen a meter stick while the complex construction of a caliper requires the child to use a saw, hammer, stapler, combination square and miter box.

The mathematical concepts are developed through exercises that have been designed especially for each instrument. An example of an exercise is finding the dimensions of a room with a trundle wheel. It is said that the trundle wheel is usable for irregular lines but not very accurate for measuring wall to wall. With the proper introduction to the trundle wheel children can solve the challenge that they face. In this mathematics activity the children are introduced to terms such as diameter, radius and circumference. The children discover the measurements of the wheel for each of these terms. Then the children do the activities and solve the problems on the activity sheet. If the children are stumped, they are guided by the teacher through questions that will allow them to arrive at the proper solution. This is only one example of the use of the instruments which are constructed.

The center is equipped with tools for 10 children. The materials are prepared for different stages, depending upon the ability level of the children. The task may call for the construction of a trundle wheel. For kindergarten children the materials may be prepared to the stage that they only need to drill holes with power drills and assemble the wheels with a screw, washer and nut. A fourth level child may be required to cut the wheel with a sabre saw and template, cut the handle to 65 centimeters, silkscreen the calibrations onto the wheel, drill holes in wheel and handle, and assemble.

In addition to developing techniques in industrial arts and mathematics in the children, it is important to be aware that reading and direction skills can be developed in them. Vocabulary and word recognition is taught according to the level of children. It is important to develop the communications skills at all levels and to expand children's opportunities to follow written directions. As a follow-up to the activities, the teacher should direct the children into a written or oral exercise to explain the procedure they followed to construct the instruments and the way they used the instruments to solve mathematics problems.

Our instruments include the caliper, depth gauge, trundle wheel, meter stick and measuring cord. These are direct measuring instruments. Indirect measuring concepts are also taught at upper levels and employ constructed instruments such as the transit, hypsometer and clinometer. Using these indirect measuring instruments involves using concepts from geometry and trigonometry. These instruments allow for experiences in areas such as surveying and rocketry.

Other instruments are also constructed in the activity center. Geoboards are constructed by the children. Many problems are solved, and discoveries are made with this instrument. In addition a balance is constructed. This item is always changing since there are many uses for a balance. The mathematics people use it in developing the number sentence. The science people use it as a simple pan balance. The science design, as an example, employs a large coke bottle, a marble, a 65-centimeter piece of lath, two rubber bands and two styrene cups.

The ability to adapt to identified needs and to develop industrial arts activities to meet those needs is the ultimate goal in our centers.

Mr. Snyder is curriculum development specialist, Industrial Arts, with the West Virginia Department of Education.

Energy

Electrical Power from the Atom

Kenneth H. Bergman

Probably J. J. Thomson in 1896 began the process of our eventual development of atomic energy. He was the one who first suggested that all things were made of similar small particles. The Curies, Bohr, and Rutherford made additional contributions through experimenting and theorizing to produce our present concept of atomic structure. (1)

The process of nuclear fission was first demonstrated by Ernest Rutherford in 1919 when he was able to bombard nitrogen with alpha particles to transmit nitrogen into oxygen, a process that was believed to be impossible. The invention of the cyclotron and the VandeGraff generator in 1931 stimulated nuclear research, as higher energies and greater variety of particle acceleration were available for the first time. Enrico Fermi theorized that it was easier to produce radioactivity by bombarding nuclei with neutrons than with alpha particles. (The alpha particle is the nucleus of the helium atom, 2 neutrons and 2 protons.) He was successful with this idea when he bombarded all elements below flourine on the atomic chart. When he was working with uranium, he found that there appeared to be a new element produced after the radiation of uranium. In 1934 he published a report of this happening and speculated that a new element had been produced as a result of this experiment. He described in this paper three chain reactions that

occurred in the formation of this new element. Two German scientists later confirmed this discovery.

In 1939, Hahn and Strassmann were able to duplicate Fermi's experiment and went one step further to produce the first fission reaction. (2) This fission reaction was not accepted as such by these scientists because of the unusual results. Previous transmutation involved only a change of one or two atoms in molecular structure; this change amounted to a splitting of the uranium into two roughly equal sized atoms.

The publication of the successful splitting of the atom triggered an attempt to duplicate this experiment in many other places such as in the United States, France and Britain.

The discovery of the fission process by these German scientists during the time of Hitler's dictatorship would have made possible Hitler's complete domination of the world had he only recognized the potential of atomic power. Fermi and his associates, who did much that led to fission reaction, were residents of Italy when Mussolini was ruling that country, and his recognition of the experiments in atomic power would have again been disastrous for the enemies of these two countries.

In 1942 Fermi was in the United States at the University of Chicago and with his colleagues was continuing to work on the bombardment of the nucleus of the uranium atom. The outcome of this work was the construction of the first atomic pile. Between 3 and 3:30 in the afternoon of December 2, 1942, Enrico Fermi announced that the atomic pile was operating on a self-sustaining basis and was producing one-half watt of power. (2)

This first atomic pile consisted of a pile of uranium, uranium oxide and graphite, about 20 by 24 by 20 feet. Each of the various materials were compressed into blocks about 8-1/2 by 4 inches and then placed in a wooden supporting lattice of the dimensions that had been computed as the critical size to cause a self-sustaining reaction. Control of the pile was accomplished by means of cadmium rods that were withdrawn to cause the pile to begin to heat. On December 12th the pile was permitted to generate 200 watts of power. (2 & 3)

Before August 1939, all experimenting with atomic energy in the United States was done without the money or backing of the United States government. Albert Einstein sent a letter to President Roosevelt to convince him that work on atomic energy should proceed as fast as possible and with the aid of the government. President Roosevelt agreed, and in January 1940, $6,000 was granted to Columbia University for fission research under the direction of the Army and Navy. (2) The atomic bomb was developed as a result of this experimenting.

ATOMIC POWER PLANTS IN THE UNITED STATES

The first chain reaction that produced any power occurred in December 1942, but the first reactor to produce power on a regular basis began in August 1951 and was a liquid metal fast breeder reactor. It was identified as the Experimental Breeder Reactor I (EBR I) and was operated by the Argonne National Laboratory. (5) The first commercial atomic power plant began operation on December 18, 1957, and was a pressurized water reactor. A boiling water reactor began operation in August 1960 and was located in Illinois. (4) The pressurized water reactor (PWR) and the boiling water reactor (BWR) are light water (ordinary water) reactors and are less expensive to operate than heavy water reactors. Other experimental types that will not be discussed are air cooled, carbon dioxide cooled, helium cooled and nitrogen cooled. Each has its advantages and disadvantages.

PRESSURIZED WATER REACTORS

The Shippingport Atomic Power Station was the first commercial power plant to operate in the United States. This reactor heats water in the area of the reactor and is maintained under a pressure of 1800 pounds per square inch at a temperature of 500 degrees F. The moderator and coolant are ordinary water, and the size of the reactor is about 6 feet by 6.8 feet. It creates about 230 megawatts of heat but generates only 60 megawatts of power (26 percent efficient).

The reactor is contained in a concrete structure and has a dome shaped top. The reactor vessel is about 30 feet high and 11 feet across. The very top has the control rod drive mechanism that moves the rods up and down according to power needs. The pressure head is found just below the rods and the head retains the steam in place so that it

leaves through the outlet nozzle. The control rod guides are located below the pressure head, and below these guides the reactor core is found. This is where the atomic reaction and the heating of the water take place. The bottom of the vessel is rounded and extends below the reactor core about twice its length; this acts as a reservoir for the water and other materials that may fall out of the core.

The reactor vessel contains about 110 tons of uranium fuel which can produce the power equivalent of 9 million tons of coal. The uranium is contained in pellets in stainless steel tubes that have been inserted into a grid pattern in the vessel. Control rods are made of aluminum or cadmium and are inserted or withdrawn as the power demand requires. Water circulates through the grid system to pick up the heat and help to hold the reactor temperature below melting.

THE BOILING WATER REACTOR

The first large size commercial boiling water reactor was started in October 1959 by the Commonwealth Edison Company and was located near Morris, Illinois. The reactor core of the newer units of the Dresden Plant contain 150 tons of uranium fuel. Uranium 238 is slightly enriched with Uranium 235 and is the fuel of these reactors. The reactor vessel is 70 feet high and weighs about 800 tons when loaded. Water circulates around the fuel rods and is heated to 546 degrees F and to a pressure of 1000 pounds per square inch. The BWR requires one less step in producing electricity and should be less expensive in construction.

The surrounding vessel of the reactor is made of thick carbon steel and lined with stainless steel. The reactor or containment building is made of reinforced concrete. The purpose of this building is to prevent any atomic radiation from escaping to the surrounding area if a leak or accident occurs. Inside the containment building there is a steel-lined concrete dry well that contains the reactor vessel, and this is the primary containment device. As with all atomic power plants built in the U.S., there are repetitious safety devices and procedures used to contain any leaks or accidents. Many foreign atomic power plants do not have such multiple safety devices, but simply use several feet of water over the top of the reactor for radiation absorption and protection.

THE LIQUID METAL FAST BREEDER REACTOR (LMFBR)

The EBR I produced the first nuclear generated power in the United States in August 1951 and continued to operate until December 1963. The EBR I was built and operated by the Argonne National Laboratory. According to many of those involved with these programs, the LMFBR is the only reasonable alternative to the future of atomic power production or any type of power production. Light water reactors presently get 1 or 2 percent of the available power from the uranium fuel, whereas the LMFBR can extract 60 percent or more of the power from the uranium.

After the EBR I was built and used, the next steps in designing and using the LMFBR were accomplished through the Sodium Reactor Experiment in 1957, the Hallam Nuclear Power Facility in 1962 and the submarine experiments which continued these steps. The EBR II and the Fermi Reactors, which began operation in 1963, produced 62.5 and 200 megawatts, respectively. The last test facility for the LMFBR is the Fast Flux Test Facility that is located in Washington state and is supposed to begin operation in 1978. From all of these experiments the final design of this first commercial LMFBR will be developed. The Clinch River Breeder Reactor (CRBRP) is scheduled for operation by 1981. Cooperation between the U.S. and West German governments has made possible the construction and operation of the Southwest Experimental Fast Oxide Reactor which also contributed to the construction of a commercial LMFBR plant, the CRBRP.

The Clinch River Plant will have a reactor power of 975 megawatts and an output of 380 megawatts of electrical power. The primary sodium will be heated to 995 degrees F, but the steam will be available at the generator at 900 degrees and 1450 pounds per square inch. The core fuel will consist of plutonium oxide and uranium oxide, and the control rods will be made of boron carbon. The over-all height of the reactor vessel is 55 feet, and it is 20 feet in diameter. There will be 217 fuel rods per assembly and 198 core assemblies; each fuel rod is 14 feet in length. There will be 150 blanket assemblies. The place that the reaction takes place is only 3 feet high and about 6 feet in diameter.

The sodium heat transfer system consists of a primary system and a secondary system. The sodium in the primary system is moved through the reactor core with a 5000

horsepower electric motor in each of the three primary sodium systems. The three secondary pumps will be slightly smaller than the primary pumps.

As the steam-operated generators will be capable of producing 350 megawatts of electrical power when the reactor is putting out 975 megawatts of heat, the plant is 36 percent efficient. Efficiency of the next plant is expected to be about 40 percent. (11)

THE ONLY ALTERNATIVE

The future needs of this country for electrical energy are expanding rapidly. In 1970 each person in the U.S. consumed 7,300 kilowatt hours (KWH) of electrical energy. In 1980, it is expected to be 13,000 KWH, almost double in 10 years. In 1990, it is expected to be 22 megawatt hours, and 33 megawatt hours by the year 2000. Much of the increased demand will be due to expanded use of electrical appliances, industrial demands, and increased use for heating and cooling that is now being supplied by gas and oil. It is expected that the entire U.S. reserve of oil will be depleted by 1995. Some of this could be saved by increased output of atomic power. Without nuclear power plants in the year 2000, coal will have to be consumed at the rate of 10 million tons per day to fulfill this electrical need. The need for breeder plants is very great, as we will run out of available U.S. uranium in 10 years.

An advantage of the breeder process is that when 10 plutonium atoms are fissioned or burnt up, there will be 12 new plutonium atoms created; this is a breeding ratio of 1.2. The plutonium produced by these plants can be used to fuel the PWR and BWR. The 250,000 tons of depleted uranium that will exist from gaseous diffusion plants in 1980 will supply the fast breeder reactors for many years to come. Over the next 50 years, the use of the breeder could reduce the need for 1.2 million tons of uranium. Plutonium presently has a value of from 4 to 5 thousand dollars per pound.

The use of sodium as the heat transfer medium has several advantages. One is that sodium does not slow the neutron bombardment process and thereby reduce the breeding effect; another is that the sodium does not need to operate under high pressures, as water does. Sodium does not vaporize easily at the operating temperature of the reactor, and the danger that water creates when it vaporizes does not exist. Special precautions are needed to prevent the sodium from coming in contact with water or air; this is accomplished by surrounding the sodium vessels with nitrogen gas. (9)

Another advantage to using the fast breeder reactor is in future costs. The cost of production in the light water reactor is about 2.15 mils per KWH; the breeder reactor produces power at a cost of 0.9 mils per KWH.

Other forms of energy should be considered for use by the year 2000. Solar energy, when properly harnessed, can supply from 5 to 10 percent. Geothermal power will be able to furnish less than 1 percent of the power needs; hydroelectric 3 percent; wind 2 percent; tides 0 percent; all by the year 2000. If sufficient money and experimenting are done, it may be possible to develop atomic fusion for future power needs. (12)

As 32 leading scientists have stated, "We can see no reasonable alternative to an increased use of nuclear power to satisfy our energy needs." They were referring to the use of breeder reactors as the alternative to producing all of our electrical power.

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The Engine of the Future

Raymond E. Crawford

In the past few years we have witnessed a growing public concern over the fate of the conventional automobile power source, the gasoline engine. Increased interest in improved fuel economy and the shadow of steadily tightening federal vehicle emission standards have produced a great deal of both support and opposition. Can the gasoline piston engine be improved sufficiently to satisfy emission control laws? Might it be replaced by some other type of power? Replace it? With what? What fuel might be used, or appropriately, what fuel will be available by, say, 1990 or 2020? Is there another engine to replace "old reliable?" When will it emerge from the obscure to the familiar? The following general statements will lead to further discussion of several possible low-emission engine candidates for the future. The future alluded to implies a time frame extending into the 1990's.

INTERNAL COMBUSTION ENGINE

If we pause and look back to the turn of the twentieth century, we observe that three competitive forms of power were about equal in prominence — steam, electric and gasoline. Steam power required an abundance of bulky plumbing with an explosion potential at every joint. Indeed, it took much courage to remain in the vicinity of an operating steam engine.[1] In spite of the fact that an electric car won the first American automobile track race, it was never again to present a competitive threat to either steam or gasoline power. The electric car never was able to achieve either acceptable range or speed. That left only the gasoline engine to start its rise to prominence as the automotive power plant of the world.

The internal combustion engine, with which most of us are familiar, uses a mixture of fuel (usually gasoline) and air within the engine. A small charge of the air-fuel mixture

is ignited inside each cylinder (or chamber of the rotary piston engine) to build pressure for the power impulse. Several extra processes are necessary to produce each power impulse. These begin with an intake process which charges the combustion chamber with air-fuel mixture. The next event is compression of the air-fuel charge followed by spark ignition. The resulting pressure rise from the expanding gases exerts great force on the piston, which in turn travels downward in the cylinder transmitting force to the crankshaft. The burned gases are expelled by the exhaust stroke, thus completing the four-stroke, five-event cycle of combustion. A V-8 equipped car traveling 60 mph requires that a new fire must be ignited about 9,600 times every minute.

The reciprocating piston engine includes the four-stroke (OTTO) cycle and two-stroke cycle. Engine types can be further classified as spark ignition and diesel (compression) ignition engines, either of which may be two-stroke or four-stroke cycle.

The gas turbine engine is another form of internal combustion engine. In the gas turbine engine, a continuous flame expands burning gases which blow through the blades of a turbine wheel causing the turbine to spin at very high speeds. The turbine shaft then transmits power to the vehicle drive-train.

EXTERNAL COMBUSTION ENGINE

The external combustion engine is one in which the fuel is burned outside the basic engine. Such engines as the Rankine cycle, Lear steam engine and the Stirling engine all are considered external-combustion engines and will be discussed later in more detail.

BY-PRODUCTS OF THE COMBUSTION PROCESS

Nearly every known combustion process yields some undesirable by-products. Carbon monoxide (CO), unburned hydrocarbons (HC), nitric oxide (NO), particulates and smoke are the principal by-products.

Carbon monoxide (CO) is an invisible, odorless, highly toxic gas formed during combustion whenever too much fuel is present for the amount of oxygen available.

Unburned hydrocarbons (HC) result from incomplete combustion. The relatively cool combustion chamber and cylinder wall surfaces may cause sufficient temperature drop to cause quenching of the flame around the perimeter of those surfaces. Some hydrocarbons contribute to the formation of photochemical smog when mixed with oxides of nitrogen in the presence of sunlight.

Nitric oxide (NO) is chemically active, and much of it changes to nitrogen dioxide (NO_2). For simplicity, all oxides of nitrogen are labeled NO_x. NO_x is the result of oxygen combining with nitrogen at high temperatures. When certain hydrocarbons are combined with oxides of nitrogen and exposed to sunlight, photochemical smog is formed. Some of the chemicals in smog present significant health hazards and some also are damaging to plant life.

Particulates are small solid particles of fuel additives, soot, iron oxides (rust) and sulfates (sulfuric acid). When the Environmental Protection Agency (EPA) became concerned over the sulfate emissions emitted from catalytic exhaust converters, several studies were initiated to determine if a threat really exists and what might be done about it. It appears that other chemicals are being formed in the catalytic process of transforming carbon monoxide and hydrocarbons to harmless carbon dioxide and water. Before the catalytic converter was required, sulfur dioxide (SO_2) was emitted from all exhausts in small amounts. The catalytic action causes some of the SO_2 to be transformed to sulfur trioxide (SO_3), which reacts with the normally present water vapor and forms sulfuric acid.

Ford Motor Company maintains that EPA overstated the problem due to an overly pessimistic set of assumptions concerning traffic density and the amount of sulfur in unleaded fuel. Ford and others are conducting research to determine the seriousness of the health and environmental threat. At present, it appears that no one has a solution other than to relax the standards for unburned hydrocarbons which, in turn, would allow removal of catalytic converters. A second solution might be to allow removal of sulfur from gasoline.

Visible smoke from a gasoline engine indicates a need for engine repair, while visible smoke from a diesel indicates incorrect adjustments. In either case, smoke is visible particles being emitted from the engine. The cloud of condensed water vapor from the exhaust in cold weather should not be mistaken for smoke.

VEHICLE EMISSION STANDARDS[2]

Federal vehicle emission standards are stated in units of grams per mile (gpm) for HC, CO and NO_x. Each manufacturer must submit new vehicles to EPA for exhaustive and stringent tests to prove the vehicle will not emit more than the allowable amount for that year model. These standards have been juggled about due to manufactuers claims that standards have tightened too much too soon. There have been other "complaints" that the excessive costs of researching ways to meet ever-tightening EPA emission standards have precluded money for researching alternative power sources. Since emission standards have been rather confusing, the following chart should help to clarify just where they stand as of February 1976:

Grams Per Mile		HC	CO	NO_x
Original	1975 Standard	0.41	3.4	0.4
Interim	1975 Adjusted	1.5	15.0	3.1
	1976	1.5	15.0	3.1
	1977	1.5	15.0	2.0
	1978	.41	3.4	0.4

FUELS

The list of fuels which can be used in an engine includes compressed natural gas (CNG), liquified natural gas (LNG), liquified petroleum gas (LPG), hydrogen, alcohol, ammonia and many blends of gasolines and diesel fuels. Most of these fuels have major shortcomings.

For instance, CNG will not provide satisfactory range, even with the trunk filled with high pressure cylinders of CNG. Liquid natural gas extends range somewhat over CNG, but requires insulated storage cylinders which are bulky and expensive. Not withstanding these problems, natural gas is in critically short supply. LPG cannot be supplied in quantities for even a small portion of the cars on our highways. These fuels could be utilized best by fleets for short range urban applications. They are, however, clean-burning or low-emission fuels.

Hydrogen has been attracting some interest in the scientific community as a practical non-polluting fuel. It appears now that a suitable storage system may be possible which could eventually lead to the practical use of hydrogen as the first non-fossil automobile fuel.[3] The processing of hydrogen calls for decomposing water into hydrogen and oxygen, its basic elements, by passing an electric current through a conductive water solution. The hydrogen will then be combined with magnesium powder inside a fuel cassette, forming magnesium hydride. The weight and volume of the storage containers is still excessive — about 513 pounds for the equivalent of 20 gallons of gasoline. Another problem is the dissipation of large quantities of heat released as the fuel container is filled. The hydride can be decomposed easily to release the hydrogen gas for use as fuel. Hydride cannot explode on impact, as gasoline or pure hydrogen might, indicating a safer fuel storage system. One foreign firm has developed a similar method of storing hydrogen using titaniferous iron granules for a different type of metal hydride.

It appears that two major obstacles remain to be overcome: 1. There are no major production facilities for hydrogen fuel, which would be necessary for any significant use by motorists, and 2. Lack of a marketing or distribution network for the exchangeable fuel cassettes which would serve as fuel tanks. Besides, a fairly costly modification is necessary with present cars in order to use hydrogen fuel. It seems that practical hydrogen fuel may be some distance in the future — perhaps, with good fortune, by 1990. Who knows? The incentive for further research with hydrogen is the promise of an almost purely non-polluting fuel in potentially unlimited quantities. Alcohol is more expensive to manufacture and has lower heat value than gasoline. It produces aldehyde emissions, which contribute to smog formation much the same as hydrocarbons.

Gasoline is still the most practical fuel for general use. It is reasonably easy to change the blending for reduced emissions and operation at various temperatures. Of course, with petroleum reserve depletion being a major concern, fuel economy has become a very real requirement for auto makers.

ALTERNATIVE POWER SOURCES

Lest we allow our view of the forest to be obstructed by trees, the first power source which will be discussed should be the reciprocating piston engine, with which we are all familiar. In spite of all its inefficiencies and shortcomings, it still is the most practical and the least expensive source of automotive power available today — and may be for some time to come.

About 50 million new cars were built during the years 1971 to 1975, many of which used twice as much fuel as those made in the 1960's. The primary reason for the enormous increase in fuel consumption was government-mandated use of emission-control equipment, adjustments and modifications. The poor old piston engine suddenly found itself in serious trouble. First, it was found to be polluting the atmosphere. As if that weren't enough, it became evident that in order to clean up the exhaust, we nearly had to ruin it. In the 1970's, engines became hard to start, hard to keep running, slow to warm up and short on power. Often it became nearly impossible to get it to stop running. Gas mileage had dropped to sometimes less than half that of a ten-year-old counterpart. In 1975, public indignation rose to new heights when a catalytic exhaust gas converter became part of most new cars to the tune of between $50 and $150 each. Now, to add insult to injury, John Q. Public is being told that he must use lead-free gasoline which may not be available in certain areas. All this has started some really serious efforts to discover realistic solutions to the problems of atmospheric pollution and petroleum fuel shortage, yet still be able to travel when and where we wish. In this age of advanced technology, it seems hard to believe we cannot find answers to the many problems connected with transportation.

We have seen the size and weight of cars take a decided downward turn in the interest of fuel economy. Manufacturers are shaving pounds, even ounces, from engine weights in their efforts to improve fuel economy. Removal of 10 or 20 pounds from an engine's total weight may seem like an easy enough task until one takes a closer look.

Chrysler Corporation has announced an electronically-controlled engine which was designed to excel in driveability, emission characteristics and economy. It is called the lean burn engine and is slated to be installed in 200,000 1976-model cars with 400 and 440 cu in powerplants. Plans are being made to apply the lean burn concept to smaller engines later. This highly sophisticated system uses a computer which receives signals from ambient temperature sensors, coolant temperature sensors, speed sensors and load sensors, then calculates the best moment for firing each cylinder. Lean burn engines are performing well at an air/fuel ration as lean as 18:1 and require no catalysts, exhaust gas recirculation or air pumps except in California.

If present plans for mileage requirements remain unchanged, 350-400 cu in engines may be discontinued by 1980-85. Smaller V-8s, 6 cylinder and 4 cylinder engines may survive for 10 years or so, providing emission standards can be met by the internal-combustion piston engine. There is always the possibility that accelerated development of hydrogen as an automotive fuel source could save the piston engine, as we know it, from eventual extinction.

STRATIFIED CHARGE ENGINE

Another innovation which might delay the demise of the piston engine is the stratified charge concept. The stratified charge principle provides for ignition of a rich air/fuel charge which burns into a very lean mixture area within the combustion chamber. The resulting average air/fuel ratio is considerably leaner than in the conventional engine.

Efforts at reducing exhaust emissions have resulted in a frustrating dilemma. Modifications which tend to reduce HC and CO emissions also tend to increase the amount of NO_x formed during combustion, and vice versa. Higher combustion temperatures and lean air/fuel ratios will reduce HC and CO emissions, while high combustion temperatures cause oxidation of the nitrogen in the air and thereby produce NO_x. The stratified charge engine utilizes a known concept. An over-all lean mixture reduces emission of CO, while NO_x is reduced by causing ignition to occur in a rich air/fuel mixture followed by further burning into a lean mixture area within the combustion chamber. The fuel charge is deliberately stratified inside the combustion chamber so as to produce a rich mixture at the spark plug and a lean mixture elsewhere. As a result, the over-all mixture is lean, efficient and cleaner burning.

Ford Motor Company is concentrating on two designs of stratified-charge engines: a divided (pre-chamber) engine and a fuel-injected engine. These are, however, only two of many possible variations of the stratified-charge concept. These engines should improve fuel economy as well as reduce exhaust emissions. Many inventors and developers have worked with variations of the stratified charge engine but Honda Motors of Japan finally marketed their pre-chamber version called the CVCC (Compound Vortex Controlled Combustion) engine. Honda uses a dual carburetor principle with a three-valve divided chamber. The pre-chamber contains a small intake valve through which a rich air/fuel charge enters from the small venturi (rich) portion of the carburetor. The spark plug extends into the rich mixture, which is ignited easily. A large, or main, intake valve opens simultaneously with the small valve to feed a lean mixture from the lean carburetor into the larger area of the combustion chamber. The charge is too lean to be ignited by an electric spark of normal intensity; thus it depends on the flame from the pre-chamber to ignite and burn through the extremely lean mixture. Fuel injection is used on some engines to inject fuel directly into the pre-chamber, and a modified lean-mixture carburetor may be used to feed the main combustion chamber.

Divided chamber engines have demonstrated the capability of combining low emissions of HC and CO with good fuel economy; however, NO_x emissions are not so good. The NO_x standard of 2.0 gpm now projected for 1977 can be met, but the 1978 standard of 0.4 gpm cannot be met without certain degradation of both performance and mileage. If the 1978 NO_x standard of 0.4 gpm remains firm, Honda will have to install exhaust gas recirculation to meet that standard. Tests have indicated that not only would driveability be degraded, gas mileage would drop about 18 percent. Ford has indicated reluctance to put a divided chamber engine into production unless they receive assurance that the 2.0 gpm NO_x standard will remain in effect for at least 10 years. Of course, once a decision to manufacture is made, Ford says several years are required to tool up for mass production.

A few years ago the news media seized upon a thread of information that Ford Motor Company had developed a unique new engine using the stratified charge concept. The idea seemed great; however, engineers said at that time they had been unable to get one to last more than approximately 3,000 miles without burning the pistons.

Ford does have, in the developmental stage, a fuel-injected stratified charge engine which has been named PROCO for Programmed Combustion. PROCO is a process in which a precise fuel charge is injected directly into the combustion chamber at exactly the right instant, depending on the driver's wishes.

A specially shaped combustion chamber in the head of the piston serves to control air motion, thereby controlling the spreading of the injected fuel cloud and, after ignition, controlling flame travel. The spark plug is located near the center of the injected fuel cloud and places a spark near the center of the fuel mass where the air/fuel ratio is rich and therefore relatively cool. After initial combustion, the flame proceeds to a fuel-lean atmosphere to achieve clean, efficient burning.

Ford Motor Company has been refining and testing the PROCO for about 20 years and recently built prototype engines for the military. Although the concept is promising for good mileage and low emissions, several more years of testing will be necessary to determine if it has the durability and reliability required to make it suitable as a replacement for today's engines.

Other methods of purifying the piston engine include lean-mix systems; raising intake manifold temperatures for improved fuel vaporization; exhaust converters more tolerant of lead fuel additives; filters for trapping particulates and, one of the more promising, a method of supplementing gasoline with hydrogen which may be generated aboard the vehicle.

The on-board hydrogen generator deserves mention as a possible development which may extend the era of the gasoline piston engine. Tests have shown that an internal combustion engine begins to misfire at a lean air/fuel ratio of about 18:1 on hydrocarbon fuel. Laboratory engines have managed to fire a 24:1 mixture; however in order to achieve the NO_x goal of 0.4 grams per mile, an air/fuel ratio of approximately 30:1 is necessary. Obviously, this is not possible with hydrocarbon fuel. Jet Propulsion Lab has developed a compact on-board hydrogen generator which supplements gasoline fuel, making it possible to burn a fuel mixture ranging from 24:1 to 340:1, depending on the amount of hydrogen injected. Operation of the hydrogen generator involves partial burning of an extremely rich (5.15:1) gasoline mixture. The unit produces a gaseous product containing hydrogen, carbon monoxide, methane, carbon dioxide, water and nitrogen. The hydrogen

in the mixture is then combined with gasoline and fed to the engine, where the lean burning results in nearly perfect combustion. Advantages of such a gasoline/hydrogen fuel over pure hydrogen are better acceleration and space-saving, since the generator is much smaller than a hydrogen storage tank.

Both thermal reactors and catalytic reactors have been tested. A nickel catalyst reactor appears to reduce soot problems, at the same time operating at a lower temperature than the thermal type reactor. Several problems have yet to be solved before this system can be put into production vehicles, but it is just possible that this system could solve at least a portion of the emission/fuel problem for some time in the future.

Any successful modification to the present piston engine that will increase fuel mileage and reduce emissions will get a multi-billion dollar jump over all other engine developments. The question, "Why not keep the piston engine which has been a good engine?" seems valid, providing it can be made to do the job and nothing better is available. Why not, indeed?

ROTARY PISTON ENGINE

The rotary piston engine is similar to the reciprocating piston engine, except that the pistons rotate instead of moving up and down. The rotary engine marketed by Mazda of Toyo Kogyo is now a familiar item throughout this country. At first, it made a big splash and was hailed as "the" engine to replace the conventional piston power plant. Several problems have plagued the rotary engine. For one, fuel mileage was not nearly up to where it should be for an engine of such small size. Secondly, internal sealing and lubrication problems, although somewhat improved, apparently are not completely resolved. Also, the Mazda Wankel type engine belts the buyer about $500 to $600 over the conventional 4 cylinder Mazda engine. At the same time GM indicated about a $1,000 premium over a conventional Vega engine. General Motors, the world's largest car maker, now has about $50 million tied up in Wankel license fees. For some reason, GM did not market their 206 CID rotary engine as planned. Some speculation points to fuel mileage as one reason. An unverified report from Japan indicates that GM will attempt to acquire an interest in the troubled Toyo Kogyo and merge that company with Isuzu, in which GM now owns 34 percent interest. This situation is of interest, considering that GM shelved their rotary engine without explanation and without any apparent good reason.

The rotary engine characteristically emits considerably more HC and CO than other types; however, its emission of NO_x is lower. The thermal reactor (burning chamber) used on the engine operates by maintaining high temperatures while injecting fresh air to burn the exhaust by-products more completely. In order for the thermal reactor to work correctly, it must be fed exhaust gases rich in hydrocarbon as well as fresh air. To provide the needed ingredients, the engine is fed a somewhat rich air/fuel mixture. The ignition is also retarded to provide a torch-like blast of exhaust gas entering the reactor. A belt-driven air pump provides the necessary air flow into the thermal reactor. One authority claims that if lead-free gasoline were used with an exhaust catalytic converter, the timing could be advanced and fuel mileage would be increased. Recently, claims have indicated that considerable improvement in mileage has been achieved for the Mazda.

Its durability surprised many who predicted that John Q. Public would destroy it quickly. Mazda stunned the U.S. auto industry in 1974 by extending the engine warranty to 3 years or 50,000 miles.

Whether it carries a label of Mazda, GM, VW, NSU, Mercedes Benz or a surprise name, the rotary engine is the only alternative power plant that is here now in volume production, and it will probably sell well for a long time.

While the rotary engine probably will not be a replacement for the conventional engine, it will surely offer some serious competition to any challengers.

DIESEL ENGINE

The diesel has long been an excellent source of power for anything from locomotives through construction equipment, stationary power and trucks. Diesel engines are noted for low emissions of HC and CO, but NO_x emissions are a different story. Another complaint heard universally is that diesels smoke and stink! Anyone who has followed a poorly tuned city bus on a hot day in heavy traffic certainly has a valid complaint. The

fact is that a diesel does not smoke if properly adjusted. On the other hand, no one has successfully reduced the foul odor of diesel exhaust to anywhere near an acceptable level. Imagine thousands of diesel powered cars in the daily stream of city traffic.

The job of cleaning up the diesel engine may be easier than cleaning up the gasoline engine, but Detroit would have us believe that rolling back the Red Sea again would be a simpler task. GM claims that 1977 emission standards listed below cannot be met. The standards are: CO — 25 grams per brake horsepower per hour; HC — 1.0 gram per brake horsepower per hour and NO_x — 7.5 grams per brake horsepower per hour.

Noise has become another factor in environmental pollution caused by trucks and other road vehicles. A GM representative was quoted in Auto Industry, August 1975, as saying that it may cost $4,450 plus per truck to encapsulate the diesel engine to bring diesel truck engine noise down to acceptable levels. A diesel powered truck is rated at about 87 decibels. When compared to GM's turbine trucks, which run about 76 db (without exhaust attenuation), the diesel is a mighty noisy piece of machinery.

Where does diesel power stand with automobiles and light duty trucks? Again, the outcry that the 0.4 gpm NO_x standard is too tough — too difficult and too expensive to achieve. According to an article in the February 1976 issue of Diesel and Gas Turbine Progress, several companies are moving toward light diesels. Volkswagon, International Harvester, and GM's Oldsmobile Division are examples of some who are moving toward automotive diesel power. The author of the above article is quick to point out that no one is expecting a mass move to diesel power and adds that if only 5 percent of U.S. passenger car production went to diesel, it would amount to 400,000 to 500,000 engines a year. Compared to the present annual production of just over 500,000 diesel engines in this country, that is quite a number.

Although the diesel has proven to be dependable, economical on fuel and long-lived, it does have some features which are not so desirable. It necessarily must be heavy because of the intense internal forces exerted upon it; cost is significantly higher than its counterpart; vibration, noise, odor and poor cold starting are enough to cause many to reject the diesel-powered automobile. Also, as pointed out earlier, NO_x emissions may prove to be a formidable barrier to future light automotive diesel engines. Another barrier which seems to be either ignored or neatly sidestepped is the fact that a shortage of diesel fuel, or rather fuel oil products, may be a major determining factor as to whether the diesel really can step up and take first place. According to oil company refinery information, crude oil is capable of yielding only 34 percent fuel oil products, which includes home heating oil, jet fuel, diesel fuel and kerosene. We are told also that fuel oils can be transformed to gasoline, but nothing can stretch the 34 barrels of fuel oils out of every 100 barrels of crude oil. On the other hand, it seems interesting that no mention is made of this subject by those who would claim that the diesel should take its rightful place at the head of the power parade. If the 34 percent fuel oil yield figure is correct, then it would seem doubtful that massive diesel fuel requirements could be met. In other words, one of these groups has to wrong.

GAS TURBINE

As early as 1791, John Barber recorded his description of a turbine powered by combustion products rather than steam. Many millions of dollars have been invested in experimental turbine engines by Ford, Chrysler, GM and others, but the fully practical application of turbine power for automobiles has so far eluded the engineers. However, turbine engines have proven their worth in aircraft, power generators and other types of stationary power. The turbine is uncomplicated, comparatively inexpensive and is durable. Maintenance is simple and failures are rare.

The turbine engine is schematically a torch blowing its flames through a set of angled blades attached to a wheel (turbine wheel). The burner, or torch, is supplied with nearly any combustible liquid fuel by a spray nozzle which sprays into the burner. Oxygen is supplied to the burner by the compressor, which is turned by a shaft connected to the turbine. The pure jet moves forward because of a combustion reaction which produces thrust. A prop jet is a turbine engine geared to a propeller which produces thrust. Obviously, pure thrust cannot be used in a car or truck because of high-temperature exhaust gas, not to mention the noise level which accompanies pure jet operation.

After many setbacks in putting turbine powered vehicles into production, it seems that most delays were attributed to high-volume production problems. No one has done

it before. A massive changeover such as producing turbine engines for cars requires development of entirely different techniques. Facilities do exist for moderate-volume production but labor costs become prohibitive. Another reason for delaying mass production of the turbine engine has been the relatively short supply and high cost of metals capable of withstanding the high operating temperatures. The higher the operating temperature of the turbine, the better the fuel mileage will be.

In February 1974, the General Electric Research and Development Center in New York announced a great breakthrough which should enable the turbine operating temperatures to be raised. A simple, inexpensive technique for making ceramic turbine hot parts from silicon carbide was the key. Common materials, rather than rare, expensive elements are dictated for high-volume production.

Ford and others now are hard at work in the search for an acceptable combination of materials and manufacturing processes necessary to produce components which will meet the demanding temperature requirements while still remaining economical enough for p. .enger car use.

.hrysler Corporation is planning to present a turbine powered compact car by the middle of the 1976 model year. The Jet Propulsion Lab of the California Institute of Technology has recommended development of both the turbine and the Stirling engine, which will be dealt with later, because of low emissions and a 30 to 40 percent reduction in fuel consumption. The fuel savings would amount to about 2 million barrels a day or about $8 billion.

GM Allison Turbine Division is striving toward three goals for the truck turbine engine development: 1. To attain performance comparable to diesel power, 2. To attain durability equal to diesel power and 3. To bring turbine fuel consumption rate to a favorable comparison level with diesel. GM now has several turbines operating in a fleet of test vehicles which includes trucks, buses, and boats. The present GM turbines operate at a low noise level — about 76 db — without exhaust attenuation. Full engine power can be applied toward braking during deceleration.

Truck emission standards for 1977 are: HC — 1.0 gram per brake horsepower per hour, CO — 25 grams per brake horsepower per hour and NO_x — 7.5 grams per brake horsepower per hour. The present GM truck turbine has been tested at the following emission levels: HC — 0.14 gram per brake horsepower per hour, CO — 1.17 grams per brake horsepower per hour and NO_x — 4.0 grams per brake horsepower per hour. The company hopes to have reached a point where production could begin by 1980, and it may offer serious competition to the diesel by 1985.

RANKINE CYCLE

The Rankine cycle engine is an external-combustion engine which technically is a closed cycle steam engine when operated on water. Several companies are working to develop steam as a practical means of powering passenger cars. One attractive point for the Rankine cycle engine is that combustion takes place at low pressure and moderate temperature in a hot-walled combustor which can have very low emissions, including NO_x.

Ford has worked several years with Thermo Electron Coropration of Waltham, Mass., in the development of a Rankine cycle vapor engine. From that effort emerged an organic working fluid which has a very low freezing point, is non-flammable and non-toxic. Thus, the freezing problem of water as well as fire and health hazards were overcome.

A burner, designed during the Ford/Thermo Electron effort, has demonstrated very low emissions of HC, CO and NO_x. Unfortunately, fuel consumption for most steam engines is very unattractive in a time when fuel waste is almost sinful. Consequently, Ford dropped the probram in January 1974.

The Lear steam engine has attracted some attention because, instead of the conventional steam piston-type engine, the Lear engine uses steam to drive a turbine at about 65,000 rpm. The extremely high speed then must be geared to suitable drive speeds for propelling a vehicle. As with other types of external-combusion engines, emission levels are low but fuel consumption is very poor when compared to present gasoline piston engines or diesel engines. At the present state of the art, it is doubtful that steam will provide suitable passenger power in the foreseeable future. Of course, the possibility of generating steam from nuclear energy could change that picture drastically. The possibility of nuclear powered vehicles presents a whole new set of problems to be solved. But, who knows what new development may pop up to enable scientists to solve these

problems? It would seem doubtful that steam power could be developed to a production-ready state before the mid 1990's or later.

STIRLING CYCLE ENGINE

The Stirling engine uses a working fluid which is a captive volume of gas such as hydrogen or helium. In operation, heat is supplied by an external burner through a heat exchanger to the working gas inside the engine. First, a cool volume of gas is compressed by a piston then heated via the heat exchanger. As heat is applied, the working gas expands, driving the piston down to turn the crankshaft. After expansion, the gas is cooled and its pressure decreases, allowing the gas to be compressed and the cycle is repeated. The original inventor, Robert Stirling, overcame the problem of separate heating and cooling sources by a displacer piston engine. The displacer piston serves to move the gas between a stationary hot chamber and a stationary cold chamber. The displacer may be driven by a crank and chain mechanism, or, preferably, by an improved mechanism developed by Philips called the Rhombic drive. This unlikely-looking unit results in a perfectly balanced engine which produces two power strokes per revolution. Philips has built 30 of the 20 hp size Rhombic-drive engines and has accumulated over 10,000 hours of durability on more than one of the units. A 180 hp size engine has been installed in a bus. These engines have been used on 5 kilowatt power generators in a multi-fuel demonstration unit. They have also been used in a pleasure yacht to demonstrate their extraordinary smoothness and quietness. So much for those applications. Now, what about passenger car use?

A more recent Stirling development, the double-acting piston, results in an engine more suited to automotive use. By wrapping four interconnected pistons into a cylindrical housing, a swashplate drive is possible. The double-acting piston simultaneously serves as a power piston and a displacer for the adjacent cylinder. The four cylinders are phased at 90° intervals around the engine, which causes four torque impulses per revolution of the swashplate. The engine is a perfectly balanced unit resulting in very smooth, quiet operation. The heat for the four cylinders is grouped into one common source from a central burner unit.

The history of the Stirling engines goes back to 1816 when a Scottish clergyman, Robert Stirling, invented a pumping engine for use in mines. It used low pressure air as a working fluid and was soon set aside because of its bulk and weight. The Stirling engine was largely abandoned until 1938 when N. V. Philips of Holland became interested in developing the concept further. In 1958, GM obtained a license from Philips and constructed a small Stirling-powered generator set which was later used in an electric hybrid vehicle. Two European companies were licensed to build Stirling engines in 1968. GM terminated work on the Stirling in 1969 and allowed their contract with Philips to expire in 1970. GM accumulated some 25,000 hours operating time on Stirling engines ranging from 3 to 400 hp. The developmental difficulties identified by GM which resulted in their dropping the Stirling program are listed below:

1. Sealing problems — hydrogen gas escaped around piston rods and through hot parts
2. Excessive weight — about 7 lb per hp
3. Excessive bulk — too large for vehicle packaging
4. Low speed limitation — top speed only 2[illegible]0-3000 rpm
5. Large radiator requirements — about 2 to 3 times conventional size
6. High NO_x emission — about 3.0 gpm as compared to 1978 EPA standard of 0.40 gpm

In 1970, Ford Motor Company joined forces with Philips in an effort to overcome the problem areas identified by GM. They decided to use a 1975 Ford Torino as a baseline vehicle for the 170 hp Stirling engine. The Stirling engine has been fitted into the Torino, and test results published May 8, 1975, look promising. Sealing problems have mostly been solved, and a one-year recharge time has been established for servicing the engine with hydrogen. The baseline Torino with 351 CID engine weighs in at 4570 pounds; with Stirling power, 4620 pounds. Changing from the original Rhombic drive Stirling to the swashplate drive enabled fitting the smaller engine neatly into the 1975 Torino. The engine can now turn up to 4500 rpm, making it totally compatible with current transmissions. Since Stirling performance appears to exceed the 351 CID Torino engine by about 20 percent, it may be that some of the extra performance can be traded for improved fuel mileage. A cooling system has been developed which appears to have solved at least most of the problems in that area. Emissions have proven to be well below 1978 standards with

measured emission levels of HC — 0.1 gpm, CO — 0.31 gpm and NO_x — 0.17 gpm. Of course the 50,000 mile durability tests and emission tests have not yet been completed but, with the external burner system, little deterioration is expected. It appears that the 70 dba noise level goal can be met. Cooling fans and burner blowers have been redesigned to reduce noise. Incidentally, 70 dba is the noise level of a Ford car being towed at 65 mph without the engine running. The average sound level of most conventional vehicles is about 80 dba.

After reading the glowing attributes of the Stirling engine, we must realize that several formidable problems remain to be solved. Only test engines have been built for demonstration. They cannot be mass produced. Cost must be minimized and complexity reduced. Methods of production must be decided upon; up sizing and down sizing methods must be dealt with.

The developmental period from 1976 through 1979 is expected to be devoted to Ford/Philips pre-production studies followed by advanced engineering studies through 1981. A production program is scheduled to begin about 1982, with the first Stirling-powered production passenger car becoming available in 1985. That's nine years away — if all goes as planned! Ford is careful to emphasize that this is an optimistic long-range plan and no matter how good it sounds now we're going to wait a while for the Stirling-powered car.

ELECTRIC PROPULSION

The subject of electric powered vehicles is far too enormous to cover adequately in a presentation of this type, and yet the outcome of most efforts of this type are somewhat alike. Most authorities agree that alternative power will eventually be necessary. Many inventors and so-called environmentalists play up the electric vehicle from emission and economy angles as being the ultimate answer.

Several battery-powered electrics are being marketed as short-trip vehicles and are being sold for a considerable amount of money, not in great numbers, however. The auto manufacturers are often blamed for not developing electric vehicles to help the energy situation.

Some of these claims and complaints deserve to be addressed and answered. As for the lower emission level of electrics, it simply "ain't so!" It would probably be extremely difficult to determine whether it is easier and/or better to control emissions from each vehicle or to treat it at the power generating station. Either way, there is pollution which must be treated. There is no best single answer to this complex question. It might even result in a net increase in pollution.

"... A vehicle that is inexpensive to own, operate and maintain?" It sounds like advertising jargon which could easily mislead many people. Would you pay $9,500 for a car with a top speed of 55 mph and a cruising range of about 40 miles, which probably is more like 30 miles? One company has an electric car on the market that fits this description. How about $500 or so for a new set of batteries every 18,000 miles at most... Terrific pay load — 300 pounds. The cost of the batteries, battery consumption, electricity for recharging and the fuel cost per mile is nearly the same as for a comparable size internal combustion engine. The weight of the batteries results in a large weight penalty in the electric.

After personally investigating one of the smaller electrics, one thought stands out: the electric has a long, long way to go before it will begin to threaten the existence of the conventional vehicles. The sales pitch urged consideration of fuel cost primarily in deciding whether to lay out $3,000 to decrease transportation costs. The fact is that the car has no heater, no air conditioner, little comfort and few safety features. Automotive News, October 20, 1975, presented an interesting comparison of the Sebring-Vanguard Citi-Car to the Honda Civic. Suppose the Honda were reduced in weight by one third and in power by a factor of 15 to match the Citi-Car; it would probably be more efficient than the Citi-Car in the use of primary fuel, and it would have a range of hundreds of miles instead of 35 miles or less. Moreover, its pollution would be distributed over the landscape, and its waste would provide abundant heat in winter. The Citi-Car's waste would be concentrated in the power generating plant and, ironically, it might use gasoline or propane to provide heat in winter.

Various batteries are being researched but due to problems of weight, size, material availability, material cost, production costs and poor power return, the suitable battery is not yet in sight on the horizon. For the electric car, everything is years away; nothing

is there yet. We will have to wait a long time for a highway electric car. But, in the meantime, how about a little run-about car that will be quiet, slow, cold and expensive?

Other sources of vehicle power would include hybrid electric which uses a gasoline engine to drive a generator. The electrical energy produced helps turn the electric drive motor, thereby extending vehicle range. Although a possible compromise between pure electric and vasoline, weight and cost penalties and system inefficiencies seriously handicap the concept.

The fuel cell concept converts fuel energy directly to electrical power. A fuel cell capable of providing power to drive a vehicle would fill an econoline van, leaving only space for the driver. The potential high efficiency and low emissions are attractive, however. If hydrogen becomes the fuel of the future, the fuel cell could be developed further.

The flywheel engine consists mainly of a very heavy wheel spinning at high speed, transferring inertia power to either the drive train or an electric generator. This concept presents some real challenges to the industry. The flywheel must be recharged (brought up to operating speed) after only a short run time – the same disadvantage as pure electric power. Also, the drive mechanism would be unreasonably complex. The flywheel engine shows little promise for future power needs.

SUMMARY

In the search for an alternative power source, the internal-combustion piston engine is sometimes overlooked. It will be around for some time to come. We will see more changes to induction and exhaust systems, sophisticated emission control equipment installed and, almost surely, a drastic reduction in size. The development of hydrogen fuel could extend the useful existence of the piston engine indefinitely. Hydrogen may emerge as the ultimate fuel, but not for several years. Lean-burn and stratified-charge engines are here or just around the corner and seem to be an improvement over conventional types.

The rotary-piston engine will surely be around and may eventually be developed to higher levels of fuel economy and emission refinements. It probably won't disappear but at present is not the panacea for pollution and fuel problems.

Diesel power, of course, will be a part of the future. Several problem areas still have to be solved to make the diesel into "the" automotive power source of the future. Developers must first solve problems of vibration, odor, emissions, noise, weight, slow starting and fuel availability. Emission standards may be a stumbling block unless NO_x standards are relaxed.

A breakthrough in the ceramics industry may mean that the turbine-powered car can be developed, mass produced and marketed. The turbine offers several advantages but a couple of formidable problems – fuel mileage and durability–still persist. There may be a turbine in your future, but probably not before 1982 or after.

Rankine cycle engines and steam turbines offer little hope at this time because of very poor fuel mileage. Perhaps some alternative fuel could improve the economy, but none are being considered at this time.

The Stirling cycle engine shows encouraging possibilities. It has demonstrated good performance, low emissions, good fuel mileage, smoothness and quietness. We may see a production Ford powered by a Stirling engine by 1985. Another point in favor of the Stirling is that it may be operated on heat from any high temperature source such as stored heat, radio-isotope heat, chemical heat or radiated heat from an electric source. The possibility of using combustionless heat raises the exciting possibility of a zero pollution vehicle.

The electric car is available now as a short-trip vehicle only. The electric emphatically is not pollution free, neither is it inexpensive. Due to the frequent recharging required, among other inconveniences, it will be a long time before a really suitable electric car will be developed. It is a pretty sure bet that several other alternative power sources will be in production before the electric.

In the past, engines were designed to convert the maximum amount of energy to useable power. In direct contrast, present efforts must be aimed at the lowest possible exhaust emission level while obtaining high fuel mileage. These requirements make it increasingly important for car owners to keep their engines well-tuned and in good condition.

Most people have little idea what is involved in bringing an "idea" car into production. First, prototypes must be built, tested and refined. Next, a second generation, or improved prototype must be built and tested for durability and performance before it can be incorporated in the mass production system. Cost studies are essential in order to weigh production costs against what the consumer (you and I) can afford to pay. Is fuel available in necessary quantity and quality at a reasonable cost? Only after hundreds of such questions are answered affirmatively can production procedures be started.

The problem areas described above are severe enough for minor alterations to known and proven products. It goes beyond even our wildest imagination when the product is a totally new and innovative one such as some of the alternative power sources discussed earlier.

We cannot predict with any certainty just what the engine of the future might be; however, we are assured by the industry that it will be virtually emission free, dependable, smooth, hopefully inexpensive to buy and economical to maintain.

FOOTNOTES

1. A Riker Electric won the first American automobile track race at Naragansett Park, R.I., in 1896 with an average speed of 26.8 mph.

2. Emission standard information obtained from Chicago Regional Environmental Protection Agency office on February 10, 1976. This information is subject to revision in the light that future standards may prove too stringent.

3. Roger E. Billings of Billings Energy Research Corporation, Provo, Utah, built a hydrogen powered car 11 years ago. General Electric Company scientists, working with two U.S. atomic energy physicists, R. H. Wiswall and J. J. Reilly, are working with government blueprints calling for mass production of a metal-hydride hydrogen storage system.

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Operating Internal Combustion Engines on Charcoal

Ross A. Fiedler

During the Arab oil embargo in 1973 most of us were anxious about its possible effects on the availability of heating oils for our homes and gasoline for our automobiles. The result of that scare was a fourfold increase in Arab oil prices without much actual sacrifice in availability. Our consumption was not greatly affected because at that time only about 14 percent of our oil supplies came from the Mideast. The embargo was not strictly maintained by the countries involved and ended in a few months. However, one result of that experience was an increased consciousness of our vulnerability to fuel shortages. We developed a sudden interest in alternative sources of energy, in particular for our transportation system since it relies about 99 percent on petroleum-based fuels. One alternative revived was the use of "gas producers" to provide fuel for internal combustion engines.

United States servicemen who were in Europe during World War II and shortly thereafter remember seeing autos, buses and trucks being fueled with wood or coal. One recalls seeing a bus stopping at the base of a hill, most of the passengers disembarking and walking about picking up sticks, broken fenceposts or anything which would burn. (1) All the materials were put in the firebox on the bus. Then the bus would proceed slowly up the hill.

Another tells of German tanks which were used for training troops and were powered by gas producers. (2) The battlefield tanks were of course operated by gas or diesel engines, but petroleum fuels were of such importance and scarcity that training efforts were often conducted with gas producers. Actually in Germany during 1941-42 there were tens of thousands of German vehicles fitted with wood-burning producers, and Germany in 1942 was beginning to run short of wood. (3) Germans also had designs for agricultural tractors, a 700-horsepower Rhine Tug, and had spent 10 years prior to 1941 designing gas producers for transportation.

In Sweden 1,000 registered gas producers in April 1940 increased to 60,000 registered vehicles in June 1941. (4) The British had a Mark VI government emergency producer (3). A gas producer designed for export from the U.S. was made by M&R Products Co., Inc., Brooklyn, N.Y. (5) However, all these portable gas producers were preceded by permanent installations. Design features of these permanent installations can be found in reference 6.

PRINCIPLE OF OPERATION

By definition a gas producer converts a solid fuel into a gaseous fuel. When applied to an internal combustion engine it converts the carbon from a solid fuel such as oil, coke, wood, charcoal into gaseous carbon monoxide which is then piped to the engine. Before entering the engine, the carbon monoxide is mixed with air as a source of oxygen so that within the engine the carbon monoxide burns to carbon dioxide with a concurrent release of heat. Before reaching the engine, the carbon monoxide and other gases from the solids combustion must be cooled and cleaned.

Since part of the combustion of the carbon into carbon dioxide takes place outside of the engine, some of the potential heat value of the solid fuel is lost. What is gained is a gaseous fuel which can be ingested and exhausted easily.

COMPONENTS

The basic system component is the gas generator, and it is the first item in the flow system. The solid fuel is burned within the generator in an oxygen deficient atmosphere so that carbon monoxide is produced. The generator is sealed except at the intended air inlet. This generator is called a crossdraft generator because the inlet air flows across the generator to the outlet. Other variations include updraft and downdraft generators. A fire door at the bottom allows ash removal, and a charging door at the top provides access for the fuel. The air inlet frequently includes a water cooling jacket because the intense heat from the bed of coals around the inlet may melt the metal. In some cases stainless steel inlet tubes are used instead of cooling jackets.

The gases leaving the generator should be 20 to 30 percent carbon monoxide for satisfactory operation. The fuel content of the gases is enhanced by 5 to 15 percent content of hydrogen which improves the engine performance. In fact in some generators water is deliberately added to the combustion chamber in small amounts to increase the hydrogen output. The other principle gas constituents are nitrogen (47 to 62 percent), carbon dioxide (1.8 to 2 percent), and methane (1.8 to 3 percent).

The cooling system is required to reduce the gas temperatures from about 240°F as they exit from the generator to about 80°F. (8) It is necessary to cool the gases so that the mixture has more density as it enters the engine. The effect is to increase the number of molecules of combustible gases in the combustion chamber so that more heat is released as the mixture burns. Since water vapor is one of the byproducts of the combustion process, the water vapor partly condenses in the cooling tubes. Consequently a valve should be included in the cooling tubes so that the water can be drained out when the unit is shut off.

The gases from the generator need to pass through filters before entering the engine. Fly ash, ammonia compounds, sulfur compounds and unburned fuel particles may all be part of the mixture. The ammonia compounds and the sulfur compounds may be acid forming in the combustion chamber and are probably best treated by a water wash. The other harmful constituents may be subjected to the more conventional filters ranging from dry elements to oil baths and cyclone separators. In some applications three different filters are used. (9) In some cases dry filter elements are included in the cooling tubes. Even though rather elaborate precautions are taken to protect the engines, engine overhauls sometimes are required at 8,000-mile intervals. (8) In some cases it was specified that spark plug insulators should be checked every 250 miles. (10)

Before the producer gas enters the engine, it must be mixed with oxygen. Typically this is accomplished with a simple valve. The volume flow rates of air and producer gas are approximately equal. Frequent adjustment of the mixing valve is sometimes required, depending upon the fuel used.

The last component in the system before the air-producer gas mixture enters the intake manifold is the throttle valve. Some attempts have been made to link the mixing and throttle valves, but generally they are operated separately.

The producer gas is admitted to the engine through the intake manifold. The low manifold pressure draws air through the complete piping system. Sometimes in order to improve performance a blower is added to the system to offset the pressure losses in the piping system and/or to act as a supercharger.

The physical dimensions of the producer gas system components are not conveniently accommodated when installing the system on a vehicle. When used for buses, the practice was generally to mount the system on a trailer and to use a pipe to connect the gases to the intake manifold. Trucks occasionally mounted the system immediately behind the cab. The passenger car versions usually consumed all the trunk space, and some even had part of the system mounted in front. (8,11,4)

OPERATION

Starting, control, performance and maintenance will be discussed in this section. First however it is important to note the necessity of advancing the engine timing when operating on producer gas. Tests conducted by the U.S. National Bureau of Standards indicate that at 1,800 rpm the spark must be advanced 10 degrees beyond that for gasoline at maximum load. (5) Presumably for today's higher speed engines additional spark advance is required.

Various methods for starting are used. Usually the engines are started on gasoline, and the low manifold pressure obtained when operating on gasoline draws the gases through the producer gas system. A torch held at the air inlet to the generator has its flame drawn into the generator so that the fuel begins burning. After a short time, depending upon the fuel used, sufficient carbon monoxide is available so that the gasoline can be shut off, and engine operation continues with the producer gas. Starting is comparatively easy with charcoal, and operation on producer gas can be achieved in about 1-1/2 minutes. (3)

A second method for starting is to run just one or two cylinders of an engine on gasoline while the producer is started. A third method employed a fan downstream of the generator which draws air through the producer and blows it into the atmosphere. The volatility of the producer gas can be observed by holding a torch to the exhaust of the fan and noting the size of the flame. When a good flame is achieved, the exhaust fan is shut off, the exhaust port is closed, and the engine is turned over with the starter motor.

Control of the engine is maintained with the producer system throttle valve. It is generally necessary to adjust occasionally the mixing valve to obtain the best operation. When charcoal is used as a fuel, a fairly consistent gas mixture is obtained from the generator throughout combustion of a given fuel charge. However when coal is used, the first part of the charge produces more hydrogen than the latter part, and frequent adjustment of the mixing valve is required to account for the changing gas mixture.

Performance on producer gas is about 55 percent of that obtained with gasoline — a rather severe penalty, but certainly better than doing without. (5) Furthermore, since most auto engines have power ratings far in excess of actual requirements, a 45 percent penalty in power should still yield adequate results. The NBS results indicated that about 11.4 pounds of charcoal equal 1 gallon of gas, which equals 1.6 to 2.8 miles per pound of charcoal, depending upon vehicle size.

If we use 11.4 as the valid comparator, it indicates that for a vehicle which operates at 15 miles per gallon of gasoline, 0.76 pounds of charcoal sre required for each mile of travel. Therefore for a 100-mile trip, 76 pounds of charcoal are required. The storage space needed for that amount of charcoal is about 5 cubic feet.

SUMMARY

The capability of gas producers was adequately demonstrated during World War II. For most general travel applications the inconveniences do not justify their use unless other fuels are not available.

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Developing the Solar Stirling Engine

Louis Menako

The principle factor which motivated 19th century inventors into efforts to build practical air engines seems to have been a widespread fear of steam boiler explosions. Early 19th century statistics are lacking, but in the years from 1862 to 1879 there were over 10,000 boiler explosions in England, and in the 40 years from 1880 to 1919 there were 14,281 recorded boiler explosions in the United States resulting in over 10,000 deaths and 17,000 injuries.

Hot-air engines date back to 1759 when the first known air engine patent was filed by the Reverend Henry Wood in Britain. It was not until 1807 that Sir George Cayley developed and engineered the first working furnace gas, open-cycle engine. Nine years later, a Scottish minister, Reverend Robert Stirling filed a patent incorporating the first closed cycle regenerative engine. In 1826 John Ericsson, a Swedish born inventor, came to England and worked on closed cycle hot-air engines until 1839, when he abandoned his work and emigrated to the United States. Lide Sir George Cayley developed and introduced the open cycle regenerative engine about 1840. Throughout the 19th century these engines were widely used in a variety of ways in Britain, Europe and the United States.

Toward the middle of the 19th century the internal combustion gasoline engine, along with the invention of the electric motor, caused the decline of the Stirling engines. By 1914 the latter were no longer available.

In 1937 Philips of Holland was searching for an engine that would be portable, silent and have a low fuel consumption. The engine was needed to drive small electric generators to operate radio equipment in remote regions where storage batteries were not readily available. A research program was started on several historic Stirling closed cycle, hot-air engines. Over the past 37 years Philips has taken great strides in developing the Stirling engine for everyday use. Recently he unveiled a four-cylinder 200-horsepower engine to meet the world's demand for cleaner air, less noise and low fuel consumption. The engine was designed for service in trucks, buses and boats. Later a second engine was designed and aimed at the automotive market. General Motors worked extensively on Stirling engines from about 1958 to 1970. In 1970 Ford entered a joint technical program with Philips of Holland to build Stirling engines with the intention of incorporating them into their 1980 automobiles.

HOW THE STIRLING ENGINE WORKS

The Stirling engine runs on the theory that when a gas-like air or hydrogen is heated, it expands, and when cooled, it contracts. The Stirling can be said to have a one-stroke cycle, meaning every revolution of the engine generates a power pulse.

To work, the displacer piston must lead the power piston. The bigger the lead, the faster the engine runs, and the smaller the lead, the slower the speed but the torque increases. The Stirling operates from 1 degree lead to 180 degree lead. At 181 degrees it would operate in reverse. As the power piston moves up, the displacer piston moves toward the cold end. The result is that the gas is compressed and pushed into the hot end of the displacer cylinder. The gas is heated in the hot end causing the gas to expand. This expansion goes around the displacer piston, but pushes against the power piston resulting in the power pulse. As the power piston is pushed down, the displacer piston travels back up to the hot end pushing the hot air to the other end of the cylinder where it comes in contact with the cooler surfaces. Here the gas is cooled causing the gas to contract, and the power piston starts back up again compressing the gas for the next cycle. If the cold end would be perfect, the gas could be cooled enough to cause a vacuum, and then the atmospheric pressure would actually draw the piston to top dead center.

UNIQUE CHARACTERISTICS

A unique characteristic of the Stirling thermal engine and one which tends to indicate the degree of perfection with which it performs the thermodynamic conversion of heat to work is the capability of the engine to function as a heat pump when work is put into the crankshaft instead of when work is taken from it as a normal engine operation. If the

fuel and the burner are turned off while the engine is producing power, the heater is allowed to cool. At some point the heater temperature becomes so low that the engine no longer supplies enough power to overcome its own friction, and the engine normally will stop. However if the engine is maintained in rotation in the same direction by driving the crankshaft from an external machine, the Stirling thermal engine will become a heat pump and continue to pump heat from the heater to the cooler. A few moments of this operation will cool the heater pipes sufficiently to cause frost to form from the moisture in the air, and the engine will continue to refrigerate the surroundings as long as power is supplied to the crankshaft.

If the engine is motored with rotation opposite the way it produces power as an engine, it will also act as a heat pump, but the direction of heat flow will be reversed. Under these conditions the engine will pump heat from the cooler to the heater, and a few moments of this operation will cause the heater tubes to become hot and heat the surroundings.

This heat pump or refrigerator operation of the engine is easily explained from the principles of thermodynamics. But it is rare to find an engine that functions thermodynamically as well as the Stirling thermal engine.

TECHNICALLY SPEAKING

The Stirling engine is a reciprocating combustion engine. It operates on a closed cycle with the working gas completely sealed within the engine and used cycle after cycle. The source of heat, such as the combustion of air and fuel, is always outside the engine cylinder. Heat is transferred to the working gas through the metal walls of the heater tubes.

In the theoretical Sterling cycle heat addition and rejection occur only at the highest and lowest temperatures of the cycle respectively. Therefore this engine has the inherent capability of achieving the ultimate maximum efficiency of a Carnot heat engine, which is the thermodynamic standard for evaluating all heat engines. The Stirling engine, like any heat engine, produces power by compressing the working gas when it is cold and expanding it when it is hot. When compressing cool gas the power piston goes up to compress the gas while the displacer pistons move to keep the gas in the engine's cold spaces. In expanding hot gas the power piston goes down on the expansion or power stroke while the displacer piston moves to keep the gas in the engine's hot spaces.

Over 1-1/2 centuries ago an imaginative and talented Scottish minister patented the Stirling thermal engine. Research and development carried on in the Netherlands recently has revived interest in the unusual engine. Potentially it is a silent, efficient and versatile prime mover of many applications.

The applications of the Stirling thermal engine are: Low emission, low noise vehicle; commercial and pleasure boats; portable generating unit; power for satellite space station; silent submarine with heat storage; sterling-nuclear submarine, cargo ship or tanker; locomotive; long range torpedo.

The advantages of the Stirling thermal engine are: Extremely low emissions; external combustion, heat source is outside the cylinder; highest efficiency of any practical heat engine; low noise level, no explosions in cylinder; no balanced forces; no valves; multifuel engine, operable from combusion, nuclear, or solar heat sources; closed cycle engine; true reversible engine, operable as heat engine or heat pump.

SOLAR ENERGY USE WITH A STIRLING ENGINE

There has been much controversy over solar and other natural powers recently. Solar energy has been used to heat homes, run cars, produce electricity and run engines.

There are many ways to capture the power of the sun, such as:

1. Through solar cells. These are thin wafers of silicone with layers of barium on top of them and two electrodes attached. When struck by the rays of the sun, electrons are excited on the wafer and ions are produced around the electrodes. When a circuit is formed an exchange of ions takes place forming a current. This current can be used to run a heater on the hot end of the air cylinder.

2. Through solar collectors. These are large black plates, normally of corrugated steel, covered by a piece of glass over which water is circulated. The rays of the sun hit the plate causing it

to heat up and turn the water from liquid to gas. The steam condenses back into water on the cool glass and drips down into a collection trough. From there it is piped to a reservoir. Water which does not change to steam runs into the trough from the collection plate. Once the water gets to the reservoir many things can be done with it, such as turning turbines, heating homes in a sauna-type manner, and heating the hot end of the air cylinder.

3. Through Freznel lens. A Freznel lens (pronounced Fra-nal) is a lens composed of concentric circles cut in glass or plastic, forming a refracting surface which will focus the light intensely into a point causing it to reach extremely high temperatures. This light can be focused on the cylinder head.

4. Through parabolic reflectors, paraboloids. A parabolic reflector is a semisphere which has angles and curves found in the mathematical science called Parabolics. It works much like the Freznel lens in that it focuses the light intensely into a point, but it does it in a different way. It is most widely used for heating things such as ovens, novelty cigarette lighters, and engines.

For our project we chose to use the Freznel lens with an infrared heat lamp and tried to focus the point of light on the end of the air cylinder. When this failed to work we used a parabolic reflector following the advice of the school physics teacher, but we have still to figure the dimensions of the paraboloid.

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Stirling Engines

Charles F. Rhoads

The Stirling engine was invented in 1816 by Pastor Robert Stirling.

Little development was undertaken on the Stirling engine until Phillips became interested in 1938. We know the Phillips Corporation best as the maker of the Norelco razor. Phillips was interested in the Stirling engine for torpedo and submarine power sources. In 1958 General Motors became interested in the Stirling engine as a power source for space applications. In 1969 the fuel cell was sufficiently developed, and it looked attractive as a power source for space work. So GM discontinued work on the Stirling engine.

Until recently it appeared that the Stirling engine was too heavy and complex for passenger car application, and the oxides and nitrogen were excessive. By 1970 Phillips had shown that most of the problems could be solved, and Ford became interested in the engine as an automotive power source. A joint undertaking was initiated to replace a 351-cubic-inch Ford engine with an equivalent Stirling engine. Ford is working primarily with automotive applications, and Phillips is still working with basic research.

Ford is the third largest corporation in this country, and Phillips is the third largest foreign corporation. Thus we would expect them to have considerable resources to employ in the development of the Stirling engine.

Through the early 1960's performance, cost and economy were the criteria which determined which engine would be used for automotive applications. In the late 1960's emissions became of primary importance. Various solutions have been proposed to solve the emissions inherent in reciprocating internal combustion engines, such as adding external control devices. Perhaps a better solution is to use an engine which is inherently clean burning, such as the Stirling which is an external combustion engine.

Conventional piston engines operate by using an expanding, compressed and heated volume of air. A Stirling engine uses the same principle, the major difference being the method by which the heat is added. In a conventional engine the heat is applied by burning fuel inside the chamber. In the Stirling engine the heat is added by an external flame through a heat exchanger, the heated head, to the working gas inside the engine. First a cool volume of gas entrapped by a piston is compressed. It is then heated by the external

heat source. As the gas heats, the pressure increases and the piston is driven downward to turn the crankshaft. After expansion the gas is cooled by an external cooling source. As pressure decreases the gas is once again compressed. Since the pressure during the hot expansion is much higher than during the cold expansion, there is a net output from the engine. The complete cycle takes place with one revolution from the crankshaft, as opposed to two revolutions required for conventional engines.

Since exchanging the hot and cooling source is a cumbersome process, Robert Stirling, for whom the process is named, conceived a refinement to overcome this problem. His invention replaced the alternate use of hot and cold sources by adding a displacer piston which moves the gas between the stationary hot chamber and a stationery cold chamber. Describing the displacer piston helps explain the principle of the Stirling engine. However the double-acting engine (which will be discussed later) is superior for passenger car application.

The displacer piston mechanism allows the heating source to be stationary at one end of the cylinder and the cooling source to be stationary at the other end. When the displacer piston moves upward, the hot working gas in the upper portion of the cylinder is moved through the heating coils or heating tubes. The gas flows through the heating coil where it is cooled until most of the working gas is in the cold section below the displacer piston. Because this gas is cooled, the pressure is low. Moving the piston back downward pushes the working gas back through the cooling coils and to the heating tubes where it is heated and forced into the hot section above the displacer piston. Since the gas is hot, its pressure is high. There are no valves in the flow path so that when the upper chamber is in a high pressure, the low chamber is also at a high pressure.

One addition is required to complete the practical Stirling engine, the regenerator. This is located between the fixed heating and cooling sources and stores otherwise wasted heat during the cooling process and permits recovery of the heat during heating process. This stored heat is equal to several times the heat added from the outside heat source.

The displacer section combined with the power section forms the basic Stirling cycle power unit. The cooling gas is compressed by the power piston as in a conventional internal combustion engine. The compressed gas is heated and as pressure increases because the displacer piston is moving a portion of the gas into the upper or hot section of the displacer section, the pressure increase is felt in the power piston. The high, hot pressure gas completes its heating cycle due to the descending displacer piston, and the power piston completes its power stroke driven by the high pressure gas. The displacer piston moving downward forces the working gas into the cooler portion of the chamber, thus decreasing its pressure. The power piston is now ready to complete the compression stroke and to complete the cycle.

There are many mechanisms required to form a simple Stirling cycle or to drive the displacer piston at a fixed relationship to the power piston (90^{o} out of phase). This can be done by crank and chain but preferably is done by an improved mechanism developed by Phillips, the rhombic drive. Since its invention in 1953 many rhombic drive engines, ranging from 1 to over 300 horsepower, have been built by Phillips. The rhombic engine is a single cylinder engine. However its characteristics are different from those of a single cylinder internal combustion engine. Not only is the engine perfectly balanced, but it has two power strokes per revolution. Thus one cylinder rhombic drive Stirling engine has the torque impulse comparable to a four-cylinder internal combustion engine.

While the rhombic drive engine has been a primary tool in Stirling engine development work, it has proven to be large and complex. A more recent Stirling development, the double-acting piston, results in an engine better suited to automotive use. Phillips has found it possible to construct an engine of four separate interconnected cylinders and to control the motion of the piston by a device which phases each of them at 90^{o} intervals. By this type of construction each piston serves as both a power piston and a displacer piston for the adjacent cylinder, thus the name double-acting.

By incorporating a double-acting piston into a cylinder, a compact swashplate engine is formed in which the four separate heating sources are grouped into one common source. The four-cylinder swashplate engine is perfectly balanced and has four torque impulses per revolution, similar to an eight-cylinder internal combustion engine. However the magnitude of the impulses are much less than those of an eight-cylinder internal combustion engine.

At the front of the engine is a single burner which supplies heat to the burner tubes. A rotating preheater is concentric with the burner; it recovers waste heat from the ex-

haust and transfers it to the incoming combustion air. A unique roll sock seal on the engine rod retains the working gases within the engine. The piston rods are connected to the swashplate by lubricated sliding bearings. A single cylinder rhombic drive engine and a four-cylinder double-acting swashplate engine were subjected to detailed design study to determine the most suitable Stirling engine for passenger car propulsion. The four-cylinder double-acting swashplate engine with 860 cc displacement was selected because it packages in the vehicle better and is lighter and more efficient.

Since 1968 Phillips has been conducting dynomometer tests on the 60-horsepower version of the swashplate engine and has accumulated more than 2,000 hours of test time on three engines. These engines are being used to evaluate various design considerations for use in the 170 horsepower engine.

Passenger cars with conventional engines are tested according to a start up and transient procedure specified by the federal government using CVS (Constant Volume Sampler) equipment for collecting and evaluating the exhaust sample. In the CVS test a vehicle containing the power plant to be investigated is placed in the chassis dynamometer, and the engine is started cold. After a 20-second idle a series of accelerations and decelerations are performed according to the specified driving schedule. The exhaust gases generated during the test are mixed with fresh air, and a portion of this mixture is pumped into a plastic bag. After the entire schedule of accelerations and decelerations have been completed, the contaminents of the bag are analyzed, and a report of grams per mile is obtained. In one Stirling engine there were hardly any of the three contaminents found in a normal internal combustion engine: Hydrocarbons, carbon monoxide, and oxides of nitrogen.

In the layout of a swashplate Stirling engine installed in a 1972 Ford Torino, for example, accommodations for the engine require no change in the vehicle length. The transmission is moved rearward by 5 inches. Minor changes in the number two cross-member suspension steering and dash are also required. The Stirling engine is cooled by the mixture of 50/50 water and ethylene glycol in a manner similar to conventional engines, except that a greater proportion of heat is rejected into the cooling system and less is rejected into the exhaust. This requires a greater cooling capacity and to accommodate a radiator of sufficient size may be a minor packaging problem. To minimize back pressure the Stirling engine has dual 2 1/2-inch exhaust pipes. However no muffler or exhaust treatment devices are required, and metal temperatures are low, thus avoiding extensive heat shielding. The Stirling engine produces torque and speed characteristics compatible with current engines so that no modifications are required in the transmission and drive line other than a mechanical link to the throttle for control of transmission shift points. These characteristics are compatible with both manual and automatic transmissions.

Exhaust noise with the Stirling engine would be low as it employs a continuous combustion process. Mechanical noise with the Stirling engine operating on a dynamometer is low as there is no impact noise due to poppet valves and internal combustion. Because of this, it is possible to achieve very low noise levels from the system. Best estimates indicate that the low noise level will also be achieved on the Stirling engine car installations, but that perhaps the largest noise source will be the combustion air blower and the radiator fan.

Engine starting is accomplished through a sequential control that activates a combustion blower, fuel flow, ignition and engine cranking. Ignition time to drive-away conditions is projected to be 15 seconds on a 70°F day, slightly more on colder days.

The Stirling engine power level is controlled by increasing or decreasing the pressure of the working gas within the engine. The working gas is stored at high pressure in a small reservoir. When increasing power, blow-down from the reservoir into the engine is nearly instantaneous. Decreasing the power is accomplished by pumping the gas back into the reservoir. Since pumping time can take up to a few seconds, power is also momentarily reduced by short circuiting the working gas from the high pressure volumes to the low pressure volumes of the engine until pumping is completed. This is accomplished within the engine.

The Stirling engine fuel control is designed so that the engine heating tubes are operated at a constant temperature of 1,470° Fahrenheit. A temperature censor mounted on one of the heater tubes is a primary control device of the air-fuel control circuit. The combustion blower is driven directly from the engine. The amount of air supplied is regulated by the temperature sensor through a throttle valve which is interconnected with

the air-fuel control to maintain a constant air-fuel ratio, 30 percent excess air.

To achieve the efficiency and a specific output required for automotive use the Stirling engine must use a working gas of low molecular weight at very high pressures in the range of 3,000 psi. More horsepower per liter of piston sweep volume and thus engine weight reduction can be achieved by varying the type of working fluid. It is evident that hydrogen is the best working gas if a lightweight highly efficient engine is to be obtained. The use of hydrogen was assumed to be used in automotive Stirling engines.

In comparing the Stirling engine with what was to be the 1976 law for automotive emissions (which has been postponed), in acceleration we would expect the Stirling engine to be equal to or slightly better than a typical car. Projections show that we would expect the fuel economy to be better than what we are obtaining from our conventional engines.

As of July 1975 Ford has installed a prototype of a 170-horsepower Stirling engine in a 1975 Torino and has started a preliminary test program in Holland before the car is shipped to the United States before the end of the year. Early test results are very encouraging. The emissions are well below the 1978 statutory levels. Ford says dynamometer testing shows a 47 percent improvement in fuel economy over the standard 1975 Torino engine and a 20 percent improvement in acceleration. A remarkable low noise level has been achieved which a spokesman says is like towing a standard Torino through the test area at 65 miles an hour without the engine running. A Ford executive emphasized it will be at least 1985 before any company could start mass production of the engine.

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The Urgency of Energy Education

Ralph V. Steeb

One of the most challenging situations today is the new awareness that the earth is running out of things. Recent events have brought to our attention that we live on a finite planet with a possible limit to certain necessary materials. Foremost among these limited materials are those which create energy for man. The fuel shortage of 1973 abruptly brought our attention and concern to the increasing demand for energy and the limitations of the resources which are currently used to supply it.

The American society and industrial enterprise run on energy. They are, in fact, dependent upon it for survival. The necessities of life now include food, clothing, shelter and energy. Today, just two and a half years after the oil crisis, most Americans are apathetic about the energy shortages in view of the seeming return to normal supply. But future shock is inevitable because the world's long-term supply of the materials currently used to produce the energy which supports human life and modern industry is limited.

The attitudes and practices of the public must be aligned with the realistic data and world resource situation. Education stands foremost as the prime motivator of energy literacy. In particular, science, social studies and vocational education can contribute an awareness to the critically pressing problems of the immediate years ahead. Industrial arts courses have for many years included the technical information about the extraction, conversion and use of energy for power. Industrial arts and industrial-vocational educators are in a key position to transmit to the youth in our school systems the

total energy-resource information and understandings which form the basis for wise decisions by the government, industry and individuals. Education as a medium has the greatest potential and responsibility for transmitting the factual energy status. The current situation requires understanding and action by an intelligent public.

Facts concerning the supply and consumption of energy-producing material resources are readily available. Although the energy crisis no longer dominates the front pages of newspapers, related information is still visible in our mass media. State and national agencies have sprung up to publicize, regulate and research factors related to energy and power. Firmly believing in the responsibility and delivery system of education, the National Educational Council on Energy and Power was organized. Energy education should be included at all levels, kindergarten through adult, for only knowledgeable persons can contribute to the solutions.

The energy crisis has far-reaching effects. It threatens our individual and social lives, our economic structure, the production output of industry and the political system. Each of these aspects is a study in itself. Yet each cannot stand alone, for a drastic reduction of energy would have a falling domino effect on all that contributes to our lifestyle and standard of living.

The shortage of raw materials leads to a shortage of energy, power and material goods. Prices of food, clothing and shelter increase rapidly. Decreases in food supply follow, with potential widespread famine. Coupled with a worldwide population explosion, the nucleus of war-producing factors grows eminent. Thus, the impending limit to the energy supply has economic and political effects.

The creation of energy sources over millions of years and their development and use over the past 200 years is a very interesting study. For thousands and thousands of years, the energy cycle was in balance. The earth received energy from the sun, a high-power source. This energy was taken in and conserved by living things. Even the advent of man did not have much effect on the natural balance. When industrialization was introduced, larger amounts of energy were being used daily than were being collected and stored. This imbalance grew proportionately larger as more and more energy was required. Scientists now predict when various fossil fuels will be exhausted.

We cannot wait until that time. Immediate conservation is urgently needed until alternate new sources can be discovered, developed and delivered. Education is a necessary element to bring an understanding and acceptance of the serious conservation measures which are needed.

Industrial arts and industrial-vocational education most closely relate to the energy crisis, its cause and its solution. While no one can predict the future with certainty, educators in these fields must center a personal involvement in the development of curricular materials on energy and power as well as encourage and support their inclusion in the instructional programs.

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Funding I.A. Programs

Status of Funding in Idaho

Douglas E. Hammer

Idaho has just broken into funding. During the summer of 1975, 10 curriculum guides were developed using clusters similar to those previously developed by Florida. These guides are consistent with the Prevocational Guidelines for funding in Idaho. They include:

For grades 7 and 8: American Industry which consists of introductory, 9-week units in graphic communications, construction, manufacturing and power and transportation.

For Grades 9 through 12: 18-week cluster courses in manufacturing, graphic communications, power and transportation and construction; 36-week cluster courses in drafting, power mechanics, industrial materials and processes, electricity/electronics and graphic arts.

To be eligible for prevocational funding in Idaho, requirements are:

1. The program must not duplicate programs already in the school.
2. The program must articulate to vocational training.
3. This program must be offered in grades 9 through 12.
4. The program must incorporate one or more exploratory cluster courses and/or prevocational development courses to prepare students to enter a vocational education program at the secondary and/or postsecondary level by:
   a. Providing occupational information and instruction pertaining to a broad range of occupations including training requisites, working conditions, earnings, benefits and other relevant information.
   b. Providing broad exploratory experiences in industrial arts laboratories including observation of business or industry to acquaint students with jobs in the related occupations.
   c. Providing for mobility of students, who complete a planned, approved prevocational industrial arts program, into vocational education.
   d. Developing the ability of students to recognize and to solve practical problems related to the approved course of study.
5. The program must assure that the district will maintain its financial effort by expending from local district funds an amount not less than that expended in industrial arts programs in the district for the year preceding the program operation under this policy.
6. The program must provide occupational guidance and counseling for students enrolled to assist them in making an informed and meaningful choice in selecting an occupational field.
7. The program must provide a teacher who holds an Idaho Secondary Teaching Certificate with endorsements in industrial arts education.
8. The program must provide for a follow-up on students who complete program requirements.
9. The program must provide laboratories, equipment and sufficient supplies to support the instructional program of prevocational industrial arts.
10. The program must provide open enrollment for male and female students.
11. The program must provide local supervision and evaluation of itself to insure accomplishment of program objectives.
12. Program administrators must submit reports of enrollment, etc. as may be required by the Idaho State Board for Vocational Education.
13. A prevocational industrial arts advisory committee to advise the district in reimbursing prevocational industrial arts programs in accord with the State Plan and these guidelines must be established.
14. Evidence must be provided of opportunity for industrial arts students to voluntarily organize, have membership in, and participate in a local industrial arts student association.

During the second semester of 1975-76 school year Idaho funded 4 pre-vocational programs.

The 1976-77 school year will see 20 programs funded. These programs involve 902 students. Anticipated 1977-78 total will be 64 programs with 2,222 students. Prevocational industrial arts programs received Part B funds which include both state and federal dollars. Each program receives reimbursement based on a formula which contains factors for student contact hours, etc. A total prevocational program would receive approximately 3,600 dollars for a school year.

In summary, Idaho has a good start!

Mr. Hammer is assistant industrial arts supervisor with the Idaho State Department of Vocational Education, Boise.

Views of Representative State Departments of Education Related to Funding of Industrial Arts Career Exploratory Programs

John O. Murphy, Jr.

Our society is made up of fine basic institutions, one of which is the economic institution where industrial arts has traditionally focused. Starting with the negative point, career education is history. It will be looked upon in the next few years like progressive education is today. If your state industrial arts progran did not take advantage of the career education movement while it was at its statistical peak on the normal curve, then it has missed an opportunity.

Career education has failed because of the following reasons:

1. Over-emphasis on the economic institution of our society.
2. Politically oriented state departments who failed to provide leadership.
3. Too much promotion by vocational educators.
4. The struggle for money which has become so great that it is broadening the gap between general education and vocational education.
5. The ability of vocational educators to talk out of both sides of their mouths, evidenced by saying they would like to use career education as a means of bringing vocational education and general education together. At the same time they are unwilling to cooperate with general educators in their attempt to break down the bureaucracy which abruptly divides our educational institution.

During 1972 the State Department of Education, in cooperation with the industrial arts profession and through the utilization of national leaders and consultants, developed the Louisiana State Model for Industrial Arts. It was designed to serve as a focal point from which to organize, produce and manage Louisiana industrial arts activities. More specifically, the purposes were:

1. To define the responsibility of industrial arts,
2. To identify Iowa activities in career education,
3. To encourage programs being planned for students on a system-wide basis,
4. To help unify the state industrial arts program,
5. To reduce the cost of implementation,
6. To provide the university with a focus for curriculum planning,
7. To encourage equipment and facility standardization, and
8. To strengthen the accountability of industrial arts teachers.

To provide a structure for State Department of Education planning and coordination, the Louisiana State Model for Industrial Arts functions in areas such as teacher certification (Bulletin 746), facilities (Bulletin 711), credits (Bulletin 741), funding, inservice education efforts and curriculum development as a decision-making base.

In the development of the model, several factors were considered:

1. The numerous requests to update Louisiana's industrial arts programs,
2. National research and trends in industrial arts,
3. Present facilities and programs which could be implemented successfully in industrial arts,
4. The educational background of teachers in the state and the current programs which could be adapted by them without total retraining,
5. The cost of the program and availability of funds to operate industrial arts in the state,
6. Federal law related to industrial arts, and
7. Louisiana's school administrative structure and supervision activities.

Specifically, the model consists of three basic stages. Stage one relates to elementary school industrial arts, Grades K-6, which indicates that construction activities and a study of the World of Work should be encouraged. Stage two consists of construction, transportation, manufacturing and communications for Grades 6, 7, 8 and 9; and an

American Industries curriculum is used as an introductory unit. This stage is considered the basic foundation for industrial arts activities. Stage three consists of a senior high school contemporary approach utilizing the curricula of visual communications, manufacturing, construction, materials and processes and power and energy for grades 9, 10, 11 and 12. For those school systems which, because of local handicaps, could not convert to the broader contemporary curriculum at the senior high school level and where present traditional programs are locally supported, traditional industrial arts in the areas of power, metals, wood, plastics, drafting, electricity-electronics, graphic arts and research and development is recommended.

The Louisiana State Model for Industrial Arts has proven that it gives professional direction which has been needed for years, and it has assisted most systems in up-dating their industrial arts programs. It has enabled systems to develop logical and meaningful educational experiences which are current with the main thrust of education in the United States. The model provides an opportunity for both males and females to explore industry.

Interdisciplinary activities are encouraged in all curricula inorder to strengthen the reading, writing and arithmetic programs by providing a vehicle for interpreting these abstract subject matters.

The Louisiana State Model for Industrial Arts was designed to broaden the industrial arts program to include more information related to our technological world of today and to identify the programs industrial arts teachers should be teaching. In other words, it was designed to expand the exploratory function of industrial arts by limiting the duration of any industrial arts course to one year while, at the same time, making sure broad flexibility was built into the model so that no local school system would be placed in such a position as not to be able to comply with state model programs.

To assure implementation of this model, the State Department of Education has restructured its efforts. Service and information sources of the department were revised over a three-year period to encourage this movement. Examples are the annual school reports which are required from every local school by most State Departments of Education. Louisiana now suggests to schools which do not meet the objectives of State Model programs that an evaluation of the industrial arts curriculum take place in order to update it. This effectively encourages the principal to review industrial arts activities carefully in order to keep his school's accreditation. Another example, probably the most effective of all, is State Department of Education Bulletin 741, which defines credits that can be granted by local schools. This publication was under revision for more than one year. Example: A student may receive one year's credit in materials and processes, one year's credit in power and energy, one year's credit in construction, etc. This effectively eliminates "thing making 1, 2 and 3" courses and causes industrial arts programs to offer a broader range of experiences to children. It also specifies State Model programs and eliminates out-of-date curricula such as leather working, arts and crafts, etc. Other examples could be given in school planning, teacher certification and supervision reports.

This change has not occurred statewide at the present, and projections are that it will take another five years to completely accomplish the goals of the State Model; however, at the present, a large portion of the State has converted to State Model programs. Most important of all, the Louisiana State Model for Industrial Arts has challenged Louisiana educators to examine industrial arts programs in a professional manner.

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Funding Industrial Education in Wisconsin

Leonard F. Sterry

During recent years the state of Wisconsin has established an industrial education concept rather than subjects of industrial arts and trade and industrial education for the elementary and secondary schools of the state. As a result when industrial arts was

included in the Vocational Education Amendments of 1972, it was possible to support with federal funds a concept which was in existence. Prior to the 1972 amendments vocational education funds were expended for "capstone" programs of industrial education with a primary focus of preparing 12th-grade students for entry-level employment and continuing occupational education.

With the inclusion of industrial arts in the Amendments of 1972 it was possible philosophically and financially to encourage school districts to develop comprehensive programs of industrial education. The 1972 amendments included a discussion of exploratory and preparatory programs. Also industrial arts was clearly identified as a part of the legislation. Therefore with objectives such as providing students with the opportunity to explore industrial occupations as a basis for self-assessment and selecting future occupations, to prepare for entry into industrially related occupations and to develop a base for further occupational education, it became possible also to attain three additional objectives identified for industrial education. The three objectives provided students the opportunity: 1) To work with elements of industry to gain an understanding of how they function in providing goods and services, 2) to explore the context in which industry has developed and continues to develop and 3) to understand the interdependence of industry and society.

It became evident that with the three objectives just stated and the two former objectives, a well balanced, complete industrial education program could be designed and be eligible for legitimate funding as a part of vocational education.

To make operational the industrial education concept, school districts are invited to submit projects to be considered for funding. In the guidelines it was clearly stated that the intent of the legislation was to be maintained and that the total concept of industrial education must be developed. As a result school districts are asked to submit specific information consistent with stated criteria including a statement giving: Evidence of need for a special project of curriculum improvement, objectives to be attained by the project, identified activities and procedures to be followed in curriculum development, description of how staff would be involved in the project, staff qualifications and an evaluation system.

School districts are asked to submit proposals only if they are interested in developing programs consistent with the guidelines just discussed. Upon receipt of the proposals by the Department of Public Instruction, proposals are evaluated by outside readers identified as being especially competent in the field of industrial education. The readers include university and public school personnel. Proposals are judged against criteria identified in the guidelines and projects displaying potential are ultimately funded.

Special projects are reimbursed at a rate of 70 percent for the 1st year, 50 percent for the 2nd year and 30 percent for a 3rd year. Although federal funds can only be committed 1 year at a time, a 3-year commitment is made to schools with the assumption that federal funds will be available. The 70 percent rate identified for the 1st year is only to include curriculum development and staff inservice programs. Emphasis is clearly placed on planning industrial education programs. Second year emphasis is placed on the acquisition of necessary equipment, materials and staff to implement the developed plan. Curriculum improvement and staff inservice programs can be continued as a part of the 2nd year of operation. The 3rd year of funding is aimed at acquiring additional equipment, if necessary, and for evaluation. Funding was established at the rates of 70, 50 and 30 percent to place major emphasis on curriculum planning and staff inservice education and lesser emphasis on the acquisition of equipment and the continuing operation of the program. Also this funding procedure provides for phasing out federal financial support enabling local budgets gradually to support the continuation of the program. This procedure enables federal funds to be redirected to other school districts to help them also to develop comprehensive programs of industrial education. The intent is to give schools sufficient funding to accomplish a given task and then to withdraw funding and redirect financial support to other school districts.

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Views of the State Department of Education with Reference to Funding of Industrial Arts Career Education Programs

Harold Winburn

Our present system of education is, in fact, two systems — general education or college prep on the one hand, and vocational and technical education on the other hand. The greatest need of our time is to unify these segments into one complete system in order to serve the needs of students better in our industrial-technical society. Industrial arts is unique as an educational program with defined functions and responsibilities in both general education and vocational and technical education. This uniqueness puts industrial arts in the position of being able to bridge the gap, especially with that part of vocational education known as trade and industrial education.

In Oklahoma we have a State Department of Education and a State Department of Vocational and Technical Education, each with its own board. The state superintendent of public instruction, an elected official, is chairman of the State Board for Vocational and Technical Education, and some individuals serve on both boards. I, as state supervisor for industrial arts, am on the staff of the state director of vocational and technical education; however, I have functions and responsibilities as the industrial arts specialist in the Instruction Division of the State Department of Education. For example, during this school year, I have participated in a series of 28 one-day regional workshops sponsored by the Instruction Division, State Department of Education. It may seem that there is a conflict of interest in this arrangement, but not so. This organizational structure has provided for a better understanding between the two groups. Not only have we been able to promote a better understanding of industrial arts and its role in education with vocational personnel, we have helped to promote a better understanding of vocational education among the academic program specialists. This relationship is providing a firm foundation upon which to build for changes in the industrial arts programs of the state to support the dual role of which we spoke. A current study is being conducted, with the ultimate goal being an articulated program of occupational exploration, beginning preparation and preparation as a joint responsibility of industrial arts and trade and industrial education.

There is a continuing need for better understanding between the two similar, yet unlike, segments of our educational program — industrial arts and trade and industrial education. The role of industrial arts is not an either/or situation. It is not a question of being either general education or vocational education. It is a question of meeting needs of individuals in a complex industrial-technical society.

As a part of vocational education, industrial arts has the responsibility for providing programs that: (A) Assist individuals in making informed and meaningful occupational choices in industry and technology; (B) Provide occupational information and exploratory experiences pertaining to a broad range of occupations including training requisites, working conditions, salaries or wages and other relevant information; and (C) Prepare individuals for enrollment in vocational and technical education programs.

These responsibilities are not incompatible; however, they can be served best through implementation at all levels of our education system. Industrial arts programs and trade and industrial education programs must identify their specific roles in the total education system so that the coordinated efforts of the two can be focused on the common goal of the best program for the student.

Industrial arts is a multi-level program that has its beginning at the pre-school level. It does not have an end point; it is a continuum that meets needs which cannot be met by any other educational program.

In Oklahoma, trade and industrial education is confined to the senior high school level and above and is considered as education designed to develop skills and abilities needed by workers to enter and make progress in employment on a useful, productive basis. On the other hand, industrial arts is considered appropriate at all levels, with unique objectives applicable to each level. Industrial arts exists at the elementary, junior high, senior high, community college, and undergraduate and graduate levels of the university.

In Oklahoma, we feel that industrial arts must maintain its identity as a separate program in order to play its dual role. Industrial arts must encourage the development of those psychomotor skills which are necessary for success in our industrialized society.

At the same time, it must promote the development of those cognitive skills which are capable of interpreting the impact of change in industry and technology.

Oklahoma has accepted the U.S. Office of Education Occupational Cluster concept as the logical approach to implementing career education. This means that we are attempting to provide exploratory programs in the areas of construction, power and transportation, communications and media and manufacturing.

The Curriculum and Instructional Materials Center of the State Department of Vo-Tech developed teacher's guides and student manuals to make the transition from conventional programs to conceptual based programs easier to accomplish. A manual in each of the four occupational areas was planned, but to date only three have been completed. These are construction, power and transportation and communications and media.

A State Plan for Industrial Arts was developed and approved by the State Department of Education and the State Department of Vocational and Technical Education for implementation on a voluntary basis. At this time, the plan does not have the effect of law, but portions of it are being implemented by school districts throughout the state.

The study referred to earlier is the first attempt in Oklahoma to fund a coordinated effort between industrial arts and vocational education to provide a continuum from the junior high or middle school level through the senior year.

Briefly, this is a pilot program for the schools in the Western Oklahoma Area Vocational-Technical School District that have industrial arts programs at the present time. There are 15 schools in this district, and 9 of them have some industrial arts.

This pilot program proposes to:

(1) Evaluate existing industrial arts programs within an area school district in light of federal legislation pertaining to the role of industrial arts in vocational education.
(2) Evaluate existing industrial arts programs within an area school district in light of vocational offerings available at the area school and in the comprehensive high schools.
(3) Determine needs for inservice training of industrial arts and vocational education teachers with regard to new concepts of teaching industrial arts, and conduct such training during the 1974-1975 school year.
(4) Determine and provide equipment and curriculum materials needed in the individual programs.
(5) Provide an articulated industrial arts-vocational education program beginning as low as the seventh grade where applicable.

This is a three-year program with funding on a decreasing basis for the duration of the program. The first year, each school will be eligible for a maximum of $2,500 for equipment and materials, the second year a maximum of $1,800, and the third year a maximum of $1,000. Each school will be asked to match the funds provided by the State Department of Vocational and Technical Education.

Teachers in the schools involved were required to attend in-service training workshops relative to the teaching of industrial arts programs that will help to implement the State Plan for Industrial Arts in Oklahoma. Teachers were paid a stipend for attending these workshops. From this pilot program it is hoped that we can gain information and experiences upon which to base criteria for approval and funding industrial arts as a part of vocational and technical education.

What have we accomplished in Oklahoma as a result of Education Amendments of 1972? More than some, less than some.

We have an office of state supervisor of industrial arts as a part of the State Department of Vocational and Technical Education with the same staff status as the other vocational education supervisors, but not the same program funding.

Industrial arts has been included in the state plan, a requisite for receipt of direct federal funding. No funds for program development were included the first year; however, we have had some funds this year for program development, as mentioned above.

Up to now the prime source of federal funds for industrial arts education has been from Part D vocational funds — exemplary programs that are significant in assisting individuals in making meaningful occupational choices. Industrial arts in Oklahoma has benefited from this source of funds in the past 3 or 4 years. We were involved in the Sand Springs Career Education Project, the state model which was funded by the State Department of Vocational and Technical Education. The Mobile Plastics Laboratory, a career education project now in its fourth year, was funded through Part D funds, as well as a pilot program in electronics and power at Moore Junior High School. We also have

...ited by career education curriculum development funds through the State Department ...-Tech. The teacher's guides and student manuals for construction, transportation, communications and media have been completed, and manufacturing is still under development. The materials were developed as a part of a special funded program.

The Ponca City Public Schools were funded for one year of curriculum development in the areas of industrial communications, industrial processes, power technology and electricity-electronics, for career education.

The Education Profession Development Council has provided funds for industrial arts teachers to "Define the Role of Industrial Arts in Career Education in Oklahoma" and for school administrators to become acquainted with the "Role of Industrial Arts in Vocational Education."

In 1975 some 150 industrial arts teachers and teacher-educators were provided a two-day workshop in the use of career education curriculum materials. Each participant received a stipend which was provided from funds made available through the Curriculum and Instructional Materials Center of the State Department of Vocational and Technical Education.

The State Department of Education and the State Department of Vocational Education in Oklahoma have a compatible philosophy as to the role of industrial arts in Oklahoma education. Industrial arts should attempt to fulfill its dual role in both general and vocational education. However, direct funding of industrial arts with vocational monies is contingent upon legislation providing support for industrial arts as a line item. Pending legislation, Congress would provide this support by identifying industrial arts in a supportive role to vocational education.

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Graphic Communications

Screen Printing on an Austerity Budget

Robert R. Roehrich and J. Michael Adams

As concerned industrial educators, we have a responsibility to our students to keep pace with the current technology of our content area. Phenomenal changes have taken place in the graphic arts, even within the last five years. Within a generation we have seen processes once rarely used emerge as significant methods within an ever-growing industry. Screen printing is one such process that has moved from the simple stage of a crude hand-cut opening to the level of sophisticated photo-generated stencils.

Linked with the problem of technological change is the reality of no-growth budgets and increased concerns for accountability in all of education. As concerned educators, we would like to add new units of instruction that will reflect current technology. However, we are faced with the realities of budget limitations which prevent us from doing so.

The purpose of our presentation today is to share with you a low-cost method of introducing a significant printing process that may not be included in many industrial arts programs because of austerity budgeting — that is, photographic screen printing.

Screen printing as we know it evolved from the Chinese and Japanese methods of stencil printing. Early methods involved simple designs which were drawn onto or adhered to open mesh fabrics. A pigment was then drawn across the fabric/stencil combi-

nation to produce an exact replica of the original design. There are basically four methods to prepare a stencil: hand cut, tusche and glue, direct photographic and indirect photographic. This presentation is designed to illustrate how to set up an indirect photographic screen printing unit.

The information presented should aid you in implementing photographic screen printing concepts in a general industrial arts program with a minimum financial outlay. It assumes a basic understanding of screen printing techniques. Included is information on stencils, frames, fabric, squeegees, a list of solutions to screen printing problems and a materials list.

The indirect photographic method has several advantages for a general industrial arts program:

1. It introduces the idea of light blockage/passage, which is the basis for all photographic image carriers in any printing process.
2. It does not require expensive equipment, nor does it require sophisticated manipulative dexterity, as does the hand-cut method.
3. It is simple, and will provide nearly 100 percent success for the student.

THE UNIT

One of the major attractions of screen printing is that a printing press is not necessary to produce an image. All of the necessary equipment can be constructed by anyone with an elementary understanding of woodworking. The unit consists of two major pieces of equipment, the screen and the squeegee; additional items may include a base board and drying rack, but these are not a requirement.

THE FRAME

A simple frame can be produced by splitting a common construction-grade 2 x 4 into approximately two-inch square stock; then shiplap or miter the pieces into rectangular frames. The inside dimensions should be at least two inches wider in all directions than the largest image area to be printed. Frames may be finished to prevent ink absorption.

THE FABRIC

Commercial screen fabrics are classed according to mesh opening size and the strength of the fiber. Within each classification, the openings are all the same. In industrial situations with fine line detail, critical registration and critical pigment particle size, this is important. However, for our use, an alternative method is to use organdy. Organdy is an inexpensive material that can be purchased in any fabric store in widths of 37, 39, 45 or 53 inches. The openings of the organdy are not predictable, but will give acceptable results if fine line detail is avoided. It is possible to stretch five screens with organdy for the cost of one screen stretched with commercial silk or mono-filament fiber.

THE SQUEEGEE

The squeegee is the tool that forces the pigment through the stencil. Commercial squeegees of plastic or rubber can be purchased; however, it is possible to purchase only the rubber blade and construct your own handles. We recommend buying 1/4 inch, medium hard, square, rubber squeegee blades as an economy move. It is then possible to cut a groove in a piece of scrap lumber and to attach the blade by the use of wood screws. The rubber material can be sharpened a number of times to maintain squareness.

LIGHT SOURCES

The screen printing industry uses large expensive light sources to expose photographic stencils. A unit that is designed to expose lithographic plates can also be used. However, most schools facing economic limitations cannot afford such equipment. Actually, any light source that emits a concentration of ultra-violet light rays can be used. We have provided three alternative light sources. The choice depends upon your individual limitations and requirements.

1. Incandescent source — a No. 1 photoflood light in a reflector shield, positioned at approximately six inches from the stencil under a glass plate; exposures will be approximately five minutes.

2. Fluorescent source — a low-cost exposure unit can be built for under $7.00 by using low operational cost fluorescent lights. (Although incandescent lights are generally utilized for similar exposure units, we believe that the economy of operating fluorescent exposure source surpasses that of the incandescent type.) The light sou[illegible]ld consist of two fluorescent tubes, 20 watts each, at approximately seven i[illegible]m the stencil under a glass plate. Exposure will generally be from 15 to 20 minu[illegible]

3. Black light source — considerably higher in emission of ultra-violet light and should thereby provide shorter exposures than either the incandescent or fluorescent type of unit. Try six 20-watt black light fluorescent lamps at four inches for nine minutes.

Light sources vary in output. To determine the proper exposure with your light source, make a test strip prior to establishing exposure times. Begin with a basic exposure time of five-minute intervals, with the suggested distances listed above. Cover all but two inches of a 2 by 10 inch strip. Move the strip across the film in two-inch increments until the last two-inch segment is exposed. This will add cumulative exposures to the previous segments. Process the test strip in Ulano A & B developer or 1 percent peroxide/water solution for approximately 90 seconds.

THE STENCIL

Ulano Blue Poly-2 presensitized foto-film on a 2-mil polyester support was chosen for this example because it has proven to have outstanding characteristics with regard to stencil resolution and exposure latitude. However, most presensitized foto-films would be suitable. Blue Poly-2 is easy to handle under most school situations and is relatively stable during storage.

Prior to adhering the stencil, it is recommended to clean the screen fabric with a mild dishwasher solution to eliminate any grease that may prevent tight adhesion of the stencil. NOTE: Organdy tears easily, so be very careful during this procedure.

EXPOSURE: Always be sure to expose Ulano Blue Poly-2 through the polyester support (shiny side). Failure to expose through the support will cause the emulsion to wash off completely.

PROCESSING: Process the Ulano Blue Poly-2 in Ulano A & B developer or a solution of 1 percent peroxide for 90 seconds and then wash out with running water at 92 to 100 degrees F. Wash the stencil until all of the blue stencil residue is removed and the image area is clear. Then "set" the image by running cold water over the stencil.

ADHERING: Place the Ulano Blue Poly-2 on a flat build-up board and allow the weight of the screen to rest on the stencil. Blot excess water off and allow to set for five minutes undisturbed. A cool air fan can speed drying.

TOTAL COST

Screen frame (28 x 40)	.96
Screen fabric (organdy)	1.10
Squeegee blade (10" at .14/inch)	1.40
Squeegee handle	.45
Stencil kit	3.00
Poster ink, per quart	3.35
Ink retarder, per quart	1.20
Ink thinner, per quart	1.10
Light sources	7.00
Total	19.56

Note: All prices are approximations based on price lists that were available at press time. All are subject to local price differences and inflationary trends.

SCREEN PRINTING PROBLEMS SIMPLIFIED

If registration of the print becomes faulty...

Cause: registration tabs are out of alignment
Solution: realign and test

Cause: the hinges holding the frame to the baseboard may be loose.
Solution: tighten and try again

Cause: the silk (or fabric) may not be taut enough over the frame.
Solution: restretch the fabric

If the screen clogs while printing...

Cause: the ink dried too rapidly, closing the pores of the fabric.
Solution: remove the screen, and wash it with a rag and solvent.

Cause: lint from printing paper, rags, or tissues is responsible.
Solution: run a still-moist print under the screen

If the print margins begin to show ink stains...

Cause: ink is too thin
Solution: with a clean rag, wipe the bottom side of the screen from time to time; alter the consistency of the ink.

If certain parts of the print do not screen well...

Cause: the ink consistency is incorrect.
Solution: remove the ink from the screen with a piece of cardboard; alter by adding the proper reducer, thinner, varnish, or whatever is required for that particular ink to improve its working characteristics. Pour the ink back onto the screen and continue printing.

Cause: the squeegee requires sharpening.
Solution: on the assumption that a make-ready does not remedy the situation, check the rubber blade of the sqeegee. It may be rounded or otherwise marred. Resharpen the blade on garnet paper or other abrasive paper.

If the image prints double or blurs during screening...

Cause: the fabric is not taut enough.
Solution: a make-ready build-up of tape applied to the defective area on the underside of the screen may correct the difficulty. If not, the fabric must be restretched.

If certain areas of the print develop unwanted specks or spots...

Cause: there are pinholes in your stencil or lint under it.
Solution: hold the stencil up to the light to locate leaks in the stencil and touch a brush filled with block-out solution to each pinhole of light that is visible.

(Summary of screen problems excerpted in part from Heller, Jules, Printmaking Today, New York: Holt, Rinehart and Winston, Inc., 1972, pp. 301-302.)

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Preparing Students for College through Drafting

Walter O. Hayes

In this presentation, the term college will include all post secondary education, with major emphasis upon the professional degree seeking programs. Assuming that those attending this special session have already been attempting to serve the srated objective, your purpose in attending is to learn of other approaches. With this in mind, I hope to provide an opportunity for audience input and questions before our time runs out.

I got an early start in this area because I taught at the junior college level before and during the time I taught in secondary school. It soon became apparent to me that students in college have little opportunity to learn certain personal skills if they miss them in high school. This applies to drafting, typing, crafts and the shop classes. My own college experience reminded me that students in the academic classes could make up for prior deficiencies only by working extra hours on weekends and holidays or in the evenings. There was little opportunity to learn the personal skills at the school library. More recently, my own high school students who graduated a few years ago indicated a disadvantage in their college industrial design classes resulting from lack of experience with tools and materials. Those entering the mechanical engineering careers have voiced the same problem.

Undoubtedly all industrial arts teachers can point with pride to students who were deeply involved with industrial arts in high school and who went on to achieve high status in business, industry or a profession. In fact, I can't recall any of my former students with skill and ambition who got sidetracked into a menial job for very long after high school. Clearly then we should be happy, not sad, when a talented and ambitious student finds his way into our department, getting in with both feet and hands. We should feel guilty only if we fail to provide the challenge and opportunity which he needs.

In the time we are together, I hope we can outline some things which have proved successful enough to repeat. We all try new ways of doing things and new things to do. When they work, we do it again. A note of caution must be entered here. Obviously the talented student must be helped without killing the spirit and interest of the less apt students. They still make up the greater number of students which we serve. We must constantly get the message to the parents, counselors and administrators that students with talent and ambition will not be directed into a career that has no stairway upward by taking industrial arts. Experience on the workbench or the beat is usually a vitamin pill that gives the ambitious worker the energy he needs to climb. The personal histories of our successful men testify to this truth. Supervision, management and ownership are best served with a wide range of experiences. At the same time the less capable student, when properly prepared, is more likely to be accepted into the industrial system, will be happier and thus be more likely to be promoted.

If you have already accepted the notion that industrial arts is for all students, you will be interested in learning what things pay off in that direction. We should outline some things that we might do to lure good students into our program. Once that objective is achieved, you will be interested in learning more ways to serve both the good students and the others who might be turned away by too much comparative competition. Essentially, this means doing worthwhile things for the students we have and giving favorable publicity and honor to students who achieve, in much the same way that it is done with sports, music and art achievement. Refer to your school paper or the school page of the daily or weekly newspapers to see how some departments give recognition to those who achieve. Until we get some school reporters interested, we must find our own way to give recognition. Contests, open house, displays and a little push on the part of teachers can generate favorable publicity. Even the achievement of teachers can provide good publicity for the department. The bulletin board in the drafting room offers an opportunity to give even the average student a shot of publicity when he does do something well. It is important that we not give all of our recognition to the "varsity" only. Every opportunity must be taken to make the student feel that he is competing with others of his ability level. Some employees design things, some draw what has been designed, some reproduce the drawings and others use the drawings made by others. We have all of these levels represented in our classes. It will be a few years in the future before each student finds which way he will work with drawings, if at all. Even those at the top level of responsibility refer to drawings at appropriate times.

We should now be ready to conclude that our own philosophy and purposes are of great importance. Parents and counselors must in some way be sold on that philosophy. While recognizing the value of industrial arts in preparing students for college, another equally valuable objective is achieved when a person discovers that college is not the best way for him to go, or perhaps that a different college or different major would be better. Too often our drafting rooms and workshops have been populated by engineering school dropouts. They might have been spared the considerable cost and embarrassment of washing out of a degree program had they been exposed sooner to the requirements of the degree program. Those who turned from an engineering college or who chose a

better way for them were as well served as those who lost their fear of college by finding that they could achieve satisfactorily for what was needed.

In many cases the choice of a technical or non-degree school will get the student where he wants with his career sooner and without the frustration of attempting a program not geared to his likes and aptitudes. If this is the case, then what must we do to make the student aware? How do we teach differently when we want college-bound students in our shops and laboratories? How do we handle classes when we have college-bound students mixed with those with other careers in mind?

METHOD

1. At the beginning level of industrial arts we must provide basic, or first level, assignments where possible, with extra credit and more challenging assignments for those who need them. The student who indicates that the basic assignments are too easy should be challenged not by more work, but with creative alternatives. If he does not seek more challenge, some way must be found to require it.

2. The grading system must be so designed that extra work is rewarded, as well as better quality. A third consideration for grading must be the degree of challenge. A point system of grading is almost essential for giving qualitative consideration to these three subjective objectives. It is easy to allow points for quality and quantity. To allow points for challenge, you need only to make the creative problem worth a given number of regular assignments. The problem may be broken into three or more parts such as preliminary sketches, specifications, details, assemblies, illustrations and others, as the problem suggests. This offers some degree of success for every student and reduces the chance of boredom. This system of alternate assignments does require that the teacher be willing to do some subjective grading. Here is where the experience and accomplishments of the teacher must be presented in subtle ways to permit students to accept subjective evaluation and to take suggestions willingly. A beginning teacher must obviously be at a disadvantage at this time.

3. The method of teaching must be as individualized as possible, with flexibility and willingness to change as the class and conditions change. The student of high aptitude must be challenged without discouraging the less capable. This requires entry-level assignments in the shop or laboratory which can offer success to nearly every student, with help from the teacher and from fellow students available when it is needed. A teacher who assigns all of the class of beginners to make a completely dimensioned drawing of a spoked flywheel with proper use of conventional practices is making the same mistake as the woodworking teacher who expects his beginning students to make a table with four identically turned legs. When such assignments are mistakenly made, we must not compound the mistake by allowing the students to abandon their project or stop work while it is improperly done. The least we can do at this point is to help the student at places that are beyond him. Where waste is a serious problem, we can require practice with less expensive materials first. Nothing kills the enthusiasm of students or discredits the teacher as much as a huge residue of rejected projects or projects abandoned. Equally discrediting to the teacher is the practice of permitting students to take home work in which parents can not find as much pride as do the students. The pride must be three ways or it is mistaken pride. One way of allowing for speed and ability differences in drafting is to put due dates on the assignments and require that work turned in early or that work that is to attain the highest grade points must be dimensioned or rendered for shape or texture. This requires some review of dimensioning practices or that only the over-all sizes be dimensioned.

4. Preparation for a college type of education may be provided through use of research and development problems, particularly at the second or third year level. I treat all seniors who have had some drafting, and who are academically qualified for college, as though they were at the same experience level. They may choose the design drafting option or the engineering drawing option or both if they wish. Requests from other teachers or departments and the principal provide us with plenty of research and development problems. We assign our wrestlers with the problem of making the rolling platform to carry the wrestling mats about the building. The swimmers may design the surf board, the starting platform or the supplemental pool ladder needed by the swimming coach. The book rack or lectern wanted by an English teacher makes a good problem for anyone. Every department sooner or later gets around to calling upon us for something. Public

relations is also served when we can serve them well. At every turn we can emphasize over and over some working principles: Success comes to those who are most willing to do more than the minimum requirement. Promotions are earned before they are granted. Good attitude and habits must constantly be stressed.

EQUIPMENT

Designers and engineers use some equipment and materials which the draftsman may not. Without knowing for sure what each individual person may need in his chosen career, we can give him something that most persons in industry will need at some step up the professional ladder. We can introduce him to:

1. The slide rule and calculator with suitable problems.
2. The vernier scale and the micrometer with appropriate problems.
3. Drafting machines and special purpose instruments.
4. Perspective devices and hand-made aids.
5. Special paper forms for sketching and illustrating.
6. Newest developments in pencils, instruments and inking devices.

CURRICULUM

If we have sold our philosophy of industrial arts for everyone and are using methods consistent with our stated philosophy, it is still necessary to build a curriculum that will contribute to the goals. The curriculum must make it easier to challenge the good student without routing those of average ability, which still must be our main ration. Our drafting program aims to attain this objective in three steps:

1. The first year helps the student learn about himself and the field of drafting by permitting him to learn first what can be done with his instruments. He develops skills and techniques in the first semester. He follows this by learning in the second semester what kinds of drawings there are and what conventional things he can do to a detail such as breaking, sectioning, exploding and rendering.

2. The second year we explore the special needs of the major industries. Selected assignments are given for those who work with wood (furniture making, architecture and cabinetwork), metal workers (sheet metal, machine shop) and technical fields (electrical, piping, welding, aircraft).

3. The senior year we separate those who have decided that college is the way they want to go after graduation from those who plan another route toward a career. If they are academically qualified to enter college and are pursuing a college prep program, we encourage them to take engineering drawing. If they have had previous drafting and are not preparing for college, we suggest they take the design drafting assignments. During the fall semester, both groups will develop a major project which requires them to use the micrometer, do some inking, learn about limits and limit dimensioning and help to decide which group to join the second half of the year. Some of the major projects for which we design and make sets of plans are turned over to the shop classes to build or make a prototype. Some projects are redesigned two or three years in a row to eliminate faults. Others are completed by the carpentry class and forgotten. Such projects have included a recreation vehicle, a vacation retreat, a garden shed, a garage, kitchen cabinets, electronics benches for the school, a woodturning lathe and a bench vise. Those now pursuing the college preparation program will spend their last semester working with problems in descriptive geometry. In this group we solve mathematics problems by graphical means. Some students enroll in both classes. We also urge all drafting students to take some shop classes. The descriptive geometry covers such problems as the use of coordinates and axes for solving problems in space and surface navigation; military ballistics; detective work; computerized production; graphic and coordinate description of points, lines and solids in space; the projection of auxiliary views; true size and shape of angles and objects in space; intersecting lines and planes; and shortest distance between lines and planes.

Our efforts toward preparing students for college have been supported for several years by testimonials of former graduates. Some testimonials come to the teacher. Some come to the school officials. Many come from the parents. Students often return to tell me what might be done to improve things for the next class. Some graduates have taken

advanced placement tests to bypass the beginning courses in college. I tend to discourage this practice. Colleges have combined, condensed and embellished their courses so as to make them more important.

I have utilized a procedure of follow-up of former students to help plan changes and to guide present students. Two examples of suggestions which have come to me from former students include more emphasis upon conventional practices in sectioning and more work in limits and limit dimensioning. Each year some students ask for my opinion of their chances to succeed in college or on a drafting job. It is a great privilege and responsibility to be able to say, "You would get to your desired place in a career sooner if you chose an area college," or "I see no reason why you should not succeed in college, but you would likely be happier or more successful in a school of design or a small college."

One can see that this approach to industrial arts does not insult, embarrass or neglect the average or below average student, but has little attraction as a "dumping ground for the lazy or the goof-off." We practice the philosophy of helping those who help themselves. No one fails my courses who makes a reasonable effort. I might encourage a low achiever to try another course rather than to try advanced work in the same thing. If you have not already visited our shops and drafting rooms in Des Moines, I hope you will find time to do so.

Mr. Hayes is a drafting instructor and sometimes shop teacher at Theodore Roosevelt High School, Des Moines, Iowa.

An Overview of New and Future Technology in the Graphic Communications

William A. Rocap, Jr.

I am going to discuss briefly new and future technological developments in the graphic communications industry. Johann Gutenberg, Alois Senefelder and Karl Kleitsch used to call it printing.

Much has been said about the future of graphic communications at trade association meetings, such as those which are conducted annually by the FTA, APA, PERI, GATF, GTA, GRI, R&E Council, PIA and TAGA. It would take quite a bit of traveling to cover all of these bases. Likewise, the various trade publications which are related to the graphic communications industry have presented interesting, factual projections of the future, based upon sound technological forecasts.

The forecasts influence planners — or certainly should do so — with the impact that many technological developments have on human accommodation, physical facilities and monetary considerations, the need for an orderly approach to the problems of reacting to the forecasts in the form of planned research and development.

Technological forecasting is very important in order to obtain the background needed for adequate planning for the future. Much of the present forecasting is based upon the technologies already existing, at least in part, at the time of the forecast. This brings us to the element of time, which becomes more and more important to us as our knowledge base continues to grow at an ever-accelerating rate.

One thing we should bear in mind is the knowledge that no technology can be entirely free of surprises. Long term predictions are frequently unintegrated, sporadic and quite incomplete.

A study made in 19[illegible]7, in which a 30-year forecast was made, completely missed the impact of the computer, atomic energy, jet propulsion, radar and antibiotics, although all had been around in principle and were awaiting development. Catastrophic historic events, such as World War II, completely changed the time-tables and, in some situations, the entire nature of the technological developments. In the field of graphic communications, energy shortages, environmental protection agency requirements, and OSHA regulations may have a similar effect on the forecasts presently being made.

Cooperative and interactive effects are called synergistic, while unexpected or accidental discoveries are called serendipitous. The development of the Polaris missile system is an example of synergism. The first Polaris submarine — the George Washington — was launched in 1967, yet it would have been almost impossible to argue in the early 1950's, before a scientifically oriented audience, that a system such as this one could be successfully developed within ten years. It required at least six technological innovations, all of which seemed to be unlikely to be completed soon enough to be of use in an early-1960 weapons system.

Many of our technological developments result from basic research which, by definition, tends to produce serendipitous (accidental) discoveries and applications, since the research is not directed toward specific practical ends. Serendipity often results when an application is found in a different field than the one intended. For example, the laser photograph or hologram may make practical three-dimensional recording and projection of information. It was invented as a result of an investigation of image magnification. The original objective was not the creation and display of three-dimensional images.

Graphic communications planners and forecasters must view their activities as being highly responsive to very sudden and unexpected developments. For this reason, their plans must retain an element of flexibility.

One may assume that planning is a process which involves continuous and near complete, timely accumulation of data on technological developments and, hopefully, dissemination and action upon the data by those who are in a position to do so. Facts must take the place of opportunism and intuition. In an industry where research dollars are in short supply, one must be assured that they are used to the greatest advantage. Relatively small pockets of research exist in the graphic communications industry. Very little research of a general nature has been developed to assure optimum application of technology to the industry. Furthermore, there is no coordination of research to assure that there is minimal duplication of effort, with its accompanying waste of time, talent and money, and to assure that much needed innovations are at least being given some consideration.

Rather than put the research and development of new graphic communications technology under government control and losing the healthy competition within a free-enterprise system which has brought us to our present high level of development, there is yet another way. One example of that other way is to have printers, platemakers, suppliers, researchers and consultants share as much as possible their knowledge, trials, successes and failures for the good of the entire graphic communications community.

In order for this system to work at its highest level of efficiency, it will be necessary to close the communications gap which exists between the printer, platemaker, researcher, consultant, etc.

New technological advances have created entirely new types of problems for those involved in the graphic communications industry. People, equipment, new raw materials, new government rules and regulations, new methods and new systems are generating entirely new approaches in order to fit our industry to the demands being made upon it by technological changes and developments.

It is characteristic of technological advancement that no field can ever be the same again. New technological developments, thanks in part to the widespread use of computers, are springing forth at an ever-increasing rate. It was once possible to buy time to think it over. But those days are past, and the luxury of deliberate delay and postponement can no longer be afforded if the aim is to survive or, hopefully, to develop a healthy, fast-growing, progressive graphic communications industry.

How does the researcher learn of the present and future needs of the supplier and printer? The obvious answer is by means of improved communications. However, it is first necessary for the printer-supplier to recognize his own needs. Without going into detail, it is essential that printers, at regular intervals, conduct examinations of their systems from the standpoint of cost, productivity and quality. In too many instances, both printers and suppliers are forced out of business because of failure to conduct critical audits of their operation and to be willing and able to correct and update their systems in order to remain competitive. Help is available in making plant audits of quality, cost and productivity from a number of knowledgeable consultants or from trade organizations such as GATF.

The supplier and researcher should be cognizant of the needs that are either not being met or inadequately being met. An inadequacy may be solvable readily by the use

of a product or system already in existence or it may require some degree of research and development. A recent example of this was the need for a reliable rotogravure pre-proofing system. The need for such a system was well known in the trade for a number of years, but until quite recently, the technology simply was not available. Recent developments in the field by several suppliers have produced very encouraging results which indicate a solution to this problem is at hand.

It is suggested that communications might be greatly improved between printer, supplier and researcher by more frequent visitation of facilities and by in-depth discussions of the state of the art of both the printer and supplier. As an example, Meredith Printing, Des Moines, Iowa, conducts three-day seminars in the printing plant, during which the attendees are shown every facet of the letterpress and offset processes as presently practiced in the plant. Both successes and failures or problems are discussed, and needs are stressed. The paper supplier, for example, is shown how his product is handled from the time it is received in the plant until it exits in the form of a finished product. No attempt is made to tell him how to make paper. Yet, he can learn from people who handle his product in large volumes daily those properties which are important, those which are of lesser importance, those which need improvement and those which need a whole new fresh approach.

An example of cooperative research here is the development of the new, super-lightweight papers with hollow micro-sphere coating materials. The paper suppliers were made aware of the need for lighter weight papers without sacrificing printability, runability or opacity. The papermaker responded with the new lightweight paper and, after running several hundred tons of the new paper, the printer reported back to the paper supplier the success of his efforts. This same cooperation, due largely to improved communication, has resulted in a considerable number of technological break-throughs or, at the very least, has paved the way to smooth the transition from one process to another in the printer's plant.

A similar communication is suggested on the part of the suppliers. Frequent meetings at the supplier's plant should be held to discuss the need for new or improved products. As new technologies are developed, they should be shown to the potential users well before they have been refined to the point at which they are ready for market. It is realized that there is some risk in doing this; ideas might be stolen and given to competitors by unscrupulous people. The risk may be minimized by showing only that which is necessary to get the idea across or by having non-disclosure agreements signed by the participants.

There is a great deal of value in showing the potential user the technology at a point where he could perhaps provide important guidance in the final development of the product or system and thus head off useless or nonproductive expenditure of time and money.

Finally, the printer or potential user of the developed technology should be willing to spend time and money to evaluate it in his plant, since he will ultimately benefit from the development.

Summing up the subject of introduction of new technology, there is a significant need for better communications between printer, supplier and researcher at all stages of the process development. It is important that the printer studies his process and makes frequent audits of his performance from the standpoint of production, quality and cost; and that he shares this information with those who can help him remain competitive. Willingness to cooperate and communicate when dealing with technological developments should yield significant benefits to printers, suppliers and researchers.

I would like to illustrate some new developments which could make marked technological changes in the graphic communications industry. Since lasers are making such a remarkable technological impact, I thought I would start out by discussing them briefly, then looking at some applications of lasers in our industry.

The term laser is an acronym for light amplication (by) stimulated emission of radiation. The laser produces and amplifies light. Laser light is monochromatic; that is, all light waves in the beam are of the same frequency. It is coherent, which means that all light waves in the beam are in phase with each other; and it is collimated – the beam remains very narrow over long distances. Laser light has a higher energy concentration and is much brighter than ordinary light. A laser consists of three components: a lasing medium, a pump or energy source and an optical cavity formed by two reflectors facing each other, one being slightly transparent.

Lasers are classified according to the amount of power output measured in watts.

A Class I laser has 0.4 microwatts maximum power. A Class II laser has 1 milliwatt maximum power. A Class III laser has 0.5 watt maximum power, and a Class IV laser has greater than 0.5 watts of power. The Class IV laser requires control measures to prevent its exposure to eyes and skin.

The most common lasers are the solid state variety, characterized by the ruby laser; the gas laser, characterized by the helium-neon, argon, CO_2; semi-conductor; and liquid. They are further classified as continuous wave (CW) or pulsed lasers.

One laser application is in platemaking. An offset plate exposure system, the EOCOM Corporation's Laserite 100, utilizes two lasers. One laser illuminates a paste-up and a second laser exposes the plate. A helium-neon laser, which operates in the red region of the electro-magnetic spectrum, observes the light from the white areas of the paste-up through a row of optical light pipes which lead to a photoelectric sensor. The exposure laser is an argon laser of high energy. It passes light to the plate, thereby exposing its photosensitive surface.

Controls are simple. The Laserite Model 100 features a system for the newspaper industry which permits exposing wipe-on Diazo offset plates in two and one-half minutes, with reproductions up to 100 line screen halftones.

The laser-graph laser platemaking method images a plate directly from a paste-up. The system consists of a scan-scribe unit which replicates the paste-up image onto the printing plate. A blank laser-plate is positioned on register pins on the "write" side of the scan-scribe unit. A paste-up is positioned on the "read" side. The paste-up is scanned by a helium-neon laser and information is transmitted to a video-processor. The signal from the processor modulates an argon laser which images the blank plate. The scan-scribed plate is a reverse image of the paste-up. This step takes two minutes. The imaged plate is put into an ablation unit where a carbon-dioxide laser vaporizes the non-image plastic substrate. Upon removal from the ablation unit, the plate needs only to be bent, punched, and trimmed. Processed laser plates provide sharp, clean text and crisp, clear halftones.

IBM Corporation has produced a printing method known as the 3800 printing subsystem. It combines a low-powered laser and electrophotographic technology similar to that used in some copiers. It can produce up to 13,360 lines of material a minute with surprisingly good quality.

Sun Graphics System's Magnascan 550 with quadro-color is a new digital scanner which will be available with a laser exposure unit. The Magnascan 550 has 20 by 24 inch input and output drums with two exposing heads, each capable of simultaneously producing either one or two color separations. With an output drum size of 20 by 24 inches, the two exposing heads can also simultaneously produce four separations up to 9 by 12 inches. All of the exposures will be on one piece of film.

The Magnascan 550 has a self-diagnosis feature, which means that the operator will be able to feed in a special eight-track magnetic tape to the scanner to check out a number of functions. To simplify set-up, the 550 scanner gives a digital read-out of the density of the original in dot percentages. It is a soft-wired digital scanner utilizing a minicomputer for all control functions.

A breakthrough in laser engraving of gravure cylinders is illustrated by the Lasag laser beam which utilizes a shaped pulse — a more energetically efficient way to create a gravure cell. The Helio-Klischograph K200 is a recent product of Dr. Rudolph Hell. It is an electronic cylinder engraver designed with the decorating and packaging printers in mind. Scanning of the copy and engraving are combined on one machine. The Hell DC-300 electronic scanner with laser eliminates the use of a halftone screen since the halftone dots are formed electronically. The large scanning input drum on the Hell DC-300 scanner can accommodate a 16 by 20 inch transparency or reflection copy.

The main control panel of the DC-300 is symbolic of the extreme capabilities of this scanner to handle complicated color separation and masking problems with ease and at high rates of speed. The laser carriage contains the laser, the laser power supply unit and the modulation unit with control electronics. The light reaches the film via a light cable and the recording head. Two drum rotations are required for recording a screen dot. Resulting negatives are much sharper, may be produced faster and processor requirements are much less severe.

The PDI Compudot electronic scanning system involves the addition of a highly specialized electronic computer to a PDI electronic color scanner. As in the case of the Hell DC-300 with laser, the PDI Compudot forms the dots electronically with high

resolution. The PDI Compudot scanner utilizes a unique, new laser-based optical system. It performs five calculations — dot size, dot shape, dot displacement, screen pitch and screen angle. The system is capable of generating over 50,000 individual dots each second.

A laser photograph is called a hologram. It may be produced by photographic techniques using the light of a laser to illuminate the subject. It requires no lens and produces a truly three-dimensional display of the original subject.

A button is pressed and paper begins to race through the press at the rate of 600 feet per minute under a steady controlled stream of ink. The process is Mead Dijet. Individual ink jets are controlled by computer, and the ink is accurately positioned on the paper. In hard cover form, Wuthering Heights (a 350-page book) was reproduced perfect copy after perfect copy at a rate of one every 37.5 seconds under computer direction.

A new development in densitometry has been produced by MacBeth Corporation. It is a very high-speed reading densitometer which is capable of reading the densities of colors on a web while running through the press at speeds up to 1,000 feet per minute. The new MacBeth densitometer features pulsed illumination, narrow band filters, solid state detectors, meets ANSI standards, is small in size and reasonable in cost.

"DILITHO" is an ANPA registered name which Harris and several other manufacturers have been authorized to use to designate a new, exciting direct-lithography system. The primary portion of the Harris Dilitho system is a brush dampener which replaces two inking rolls on the ink drum of a newspaper letterpress. Water is metered onto the ink drum. In the Harris Dilitho system, saddles on the plate cylinder, where stereotypes were previously mounted, permit the use of inexpensive offset plates on a newspaper press. Such a conversion to Dilitho can be made at a fraction of the cost of an offset press.

A number of installations of Dilitho systems are in use throughout the country. A Harris Dilitho system has been installed on the Hoe newspaper press, printing the Des Moines Register and Tribune. Other dilitho systems include those by Dahlgren, which use a resilient covered form roller instead of a brush to deposit water on the ink train, and by Inland Roto-Screen, which features a dampener that meters water to the ink drum by blowing it through a rotating screen. The Inland Roto-Screen system has been installed on the press at the Kansas City Star. The use of the new system greatly improves the quality of reproduction, and dollar savings are substantial.

The Opticopy imposing camera is a programmable step and repeat camera which is capable of converting separate pieces of original copy into a one-piece, full-sized flat. Copy is punched on centers with a pneumatic two-headed punch. The copy is brought to the camera operator properly sequenced and oriented. The operator loads the film on pins, then loads the copy. Reflection copy is loaded onto a 24 by 24 inch vacuum-backed copy board. The unexposed film is loaded on the stepping easel. The system eliminates tedious hand-stripping. It produces one-piece film flats. Opaquing is reduced to a minimum. The camera has proven highly successful in book production.

The Harris Telecolor system brings automated color control directly to the press where color can be controlled more accurately, faster and with greater ease. A Cathode Ray Tube (CRT) display at the press control console is used to indicate the key positions. A form of multiplexing is used so that the operator can select the fountain he wishes to control. The CRT automatically displays the key positions of that fountain.

The 3M brand Pyrofax imaging system has bridged the gap between platemaking efficiency and web and sheet-fed press production. The Pyrofax imager features the dry Magne-Dynamic development technology. A photosensitive trans-film passes through the completely dry imaging process, then the image is transferred to a transmat. The transmat is pinned on the Pyrofax fuser's cylinder. The plate is inserted at the back of the fuser. The image is transferred to the plate. One-hundred-thousand impressions per plate have been produced.

3M has introduced "easy release transfer key" for pre-press proofing. Each factory pre-coated carrier sheet of color pigment is laid down in sequence on a single sheet. Beginning with cyan, the color pigment is laminated onto the base material using the new 3M MR-424 processor. This same cycle is repeated with each color, producing a quality four-color transfer key proof on a single sheet that looks like a finished printed job.

The 3M Company has recently introduced a complete line of graphic arts film identified as QA MARK IV. The films are available in various speeds, contrasts, and thick-

nesses. The company claims to have eliminated all high polluting substances from coatings on both sides of the film. This provides minimum pollution potential and conforms to federal and state standards.

One answer to the problem of environmental polution caused by driving ink solvents into the atmosphere is the use of press coatings where a specially designed coating material such as Eastman alcohol-soluble propionate (ASP) is applied directly over the wet ink film. The coating is dried by application of infra-red radiation or warm air and forms a protective seal over the ink so that it will not rub or mark. The ASP coating not only protects the ink film from abrasive action, but enhances the appearance.

Another example of press-coating is the application of a coating of an ultraviolet (UV) curing varnish over conventional inks. The UV varnish seals in the wet ink, prevents marking and environmental pollution.

Closely related to press-coating is powder-coating which is accomplished by the Shamrock Chemical powder-set curing system of ink drying which uses an electrostatically applied power to set a wet ink film. A micro-photograph would show how the powder, which is deposited only on the ink, is fused over the wet ink. The powder fuses on each halftone dot, protecting the ink film and eliminating pollution.

DuPont's photoproducts department has continued to perfect the cromalin pre-proofing system, recently announcing new cromalin process color. Many printers and platemakers have found the cromalin pre-proof to be accurate and economical compared to press proofing. Printers have found it possible to match cromalin proofs on the press. A number of cromalin users have been urging DuPont to develop a negative-working cromalin for some time. Recently, at Graph-ex 75, this product was shown. Another new development designed to make the cromalin system even faster and more uniform is a new powder applicator called the autotoner.

One more product introduced rather recently is the DuPont Cyrel flexible plate which utilizes the dycril platemaking process. This is produced directly from a film, rather than indirectly from an engraving. The Cyrel system is finding new customers in many graphic arts applications.

Metrication is in the near future and it will affect the platemaker, the printer and the publisher. It is time to learn more about the metric system and how it will affect you.

BASF Wyandott has started to produce a new line of printing plates aimed at the newspaper field and other users of flexible relief plates. It is the Nyloprint liquid plate system for direct printing and mat molding.

An entirely new type of film has been introduced to the market place by Scott Graphics and others. The Scott SGTM Positive II film is molecular-imaging, dry-processing and yields very high resolution. Its actinic density is said to be equal functionally to silver halide lithographic films. Dow Chemical Company has developed a new material for use as a paper coating pigment. It consists of extremely small hollow polystyrene spheres which produce ultra-lightweight papers with good opacity. These new light-weight papers yield good printability and have run quite well on high-speed production runs.

Electrostatic Corporation built an electrostatic web printing unit which causes an electroscopic ink to be electrostatically moved through a metal screen in the form of a continuous belt onto a moving web of paper. Electrostatic printing is impactless, thus many unusual shapes and textures may be printed with surprisingly good quality and speed.

One of the most difficult problems facing the printer today is pollution control, particularly the handling of stack exhausts from the presses. Electri-Graphics Corporation has developed a new concept in ink setting. It uses an ink setting device called the electricure system, and it changes a monomeric ink film into a polymer by bombarding it with a stream of electrons. It is being tried by at least one printer at this time. The more conventional polymerizing type system is ultra-violet drying, where a monomeric methyl methacrylate is polymerized by exposing it to an ultra-violet light source such as a thermogenics UV lamp.

Laws have been passed concerning environmental quality and we must comply with these laws within a reasonable time, or at least show that we are making an effort to do so. General Printing Ink Division of Sun Graphics is but one of many ink companies doing considerable work on finding solutions to the problems of pollution through research and cooperative efforts with the printers.

I have presented a sampling of some of the new and future technology which is either now available or soon will be available to the graphic communications industry. I trust it will stimulate you to look further into some of these developments and to continue to

keep informed by attending technical meetings, carefully reading trade literature and discussing new developments of equipment and materials with your suppliers.

Mr. Rocap is Director of Research, Development and Training, Meredith Printing—Division of Meredith Corp., Des Moines, Iowa.

Photographic Technology in Graphic Communications— Applications You Can Use in Your Drafting Class

Carlton E. Salvagin

Every professional journal you read and nearly every presentation you hear challenges industrial educators to keep abreast, interpret contemporary developments and practices, and add, add, add to the already bursting curriculum. We are constantly being bombarded with criticisms of teaching traditional course content at the expense of newer technological innovations.

To assist in the determination of relevant curricular content, each of us as professionals must not only look at the present state of the industrial technologies and reflect upon the past, but we must attempt to project the state of the art into the future. This is where our students will be employed as contributing members of society.

Industrial drafting and graphic communications have undergone considerable change in recent years due primarily to the constantly increasing volume of documents and demand for rapid, efficient services. Scientific discoveries coupled with the necessity to economize have brought about many technological innovations. One such innovation which has had considerable impact upon corporate communications is the development of photographic technology.

The National Association of Photographic Manufacturers (1957) explains that industrial uses and applications for photography have been expanding rapidly as industry has come to appreciate the many ways in which photography can be of service. New technologies and new ways of using old technologies are continually providing better ways of coping with the tremendous volume of documents required for manufacturing, contract construction and related fields. The association further states that photography, used properly, will reduce planning time, improve the products, add to the knowledge available about an operation in the production activity and increase profits.

PHOTOGRAPHIC TECHNIQUES IN GRAPHIC COMMUNICATIONS

Graphic communications in industry is comprised of seven components: Graphic arts, commercial art, drafting, illustration, photographic reproduction, line communication and advertising. Following is a compilation of photographic techniques used in graphic communications which aid in facilitating more rapid and economical services.

document reproduction	storage and retrieval systems
graphic representation	size and enlargement reduction
document preparation	automated drafting systems
document restoration	offset plate preparation
document preservation	printed and integrated circuit preparation
document control	microfilming
corporate planning	photogrammetry
quality control	illustration
high speed analysis	miniaturization

publication	cartography
product photography	films
inventory	time study

During the past decade there have been many changes in industrial policies with respect to the manner in which drawings have been handled. Looking at the situation from the economic viewpoint, it is immediately evident why the production and safeguarding of engineering drawings becomes a matter of applying strict drawing control procedures. Such items as standardization of paper sizes, simplified drafting procedures, assignment of drawing numbers, filing of drawings, microfilming, disaster files, printmaking, print distribution, print destruction, drafting coats, drawing procedures and drawing retrieval are all important aspects of proper drawing control.

Photography has had several effects upon drawing control in industry. Some reasons for using photographic materials in graphic communications are to:

1. provide a "second" original
2. restore old original drawings
3. speed drawing changes
4. save drafting time through the use of photodrawings
5. reduce re-draws through the use of phototemplates
6. eliminate retracing of existing white prints, blue prints, or old faded tracings of original drawings
7. enlarge or reduce drawing size
8. insure workable "blow backs" by microfilm
9. simplify changes in circuit layouts
10. improve clarity
11. make better copies possible

(Eastman Kodak Co., 1973)

PHOTOGRAPHIC APPLICATIONS YOU CAN USE

Photosketching

Photosketching is the process of sketching with pencil or technical pen directly on a photographic print and then chemically eliminating the photographic image. Stippling or line sketching techniques can be used to provide variations in textures and shaded areas. When the desired areas of the print have been sketched, place the print in a solution of 1 oz tincture of iodine and 2 oz water for about three minutes. Agitate slightly. Be sure not to touch the sketch during the entire process. Place the print in photographic fixer for three to five minutes. Agitate slightly until the photographic image has completely disappeared. Wash the print in running water for about 20 minutes and dry in a warm dryer or between sheets of blotting paper. Additional sketching or details may be added at this time. Try not to over-do it. The result will be an expertly executed sketch or rendering of the original subject. NOTE: If you wish a photograph/sketch composite, the photo image which you wish retained can be coated with rubber cement. The iodine solution will not penetrate the cement coating. After drying, the rubber cement can be rubbed off with the fingertips.

Photo Illustration

When the three-dimensional configuration of a product or model is of primary concern, a photograph can often be produced more rapidly and communicate better than a mechanically drawn pictorial representation. The camera can be hand-held or mounted on a tripod and the object or model positioned to provide the best pictorial representation. By using movable and hand-held photo-flood lights, shadows and characteristic features can be accentuated. Background is often plain paper or cloth so as not to detract from the object definition.

Photo Assembly

Exploded pictorial assembly drawings are very useful in assisting persons who are not skilled in reading regular multiview drawings to perform work at the assembly bench. This type of drawing is frequently found in repair manuals and parts replacement catalogs. Substituting an exploded photo assembly for a pictorial line drawing can often save considerable drafting time as well as improve the rapidity and level of communication.

We have found the use of a copy stand and tripod mounted camera most appropriate although some distortion becomes evident because of the inability of the objects to conform to the desired axes. Shadows are produced by the photoflood lamps which present unnatural representation and the depth of field is often poor on larger objects due to the close relationship of the camera lens and object. Plus-X or Panatomic-X film is recommended, since tonal ranges and relatively soft contrast are desired.

In preparing for pictorial photography, axes are lightly drawn on a large sheet of white paper which is taped in place on the copy board. (Isometric axes are most often used.) Either of two angular relationships may be set up: (1) Using a large 30-60 degree triangle, establish a 30-degree angle between the camera and the junction of the axes in the center of the copy board. Objects may be placed upon the proper axes, camera focused, and shots taken. (2) Using a large 30-60 degree triangle, establish a 60 degree angle relationship between the camera and the axes junction. Objects may now be placed upon the proper axes, supported at an angle of 30 degrees to the copy board with modeling clay, camera focused, and shots taken. This method is preferred due to the better lighting and shadow relationships. NOTE: Hand-held photo-flood lamps often assist in accentuating desired features.

Once the angular relationship between camera and copy board is established, care must be taken not to disturb it since sequential photos of additional parts must bear this same angular relationship.

Light readings are now taken, shots made and the film developed. When dry, the film is placed in the enlarger for projection printing. Care must be exercised since size relationships can be distorted greatly if adjustments are made, other than focus, between the printing of the various frames.

Following print development and drying, each individual part is carefully cut out and a paste-up photo-drawing is made. Center lines, leaders, "balloons," part numbers and parts list can be added now. Prints can be made by photographing the paste-up. Enlargements of any size may be made through projection printing.

Product Photography

Product photography is most often used in sales and the preparation of advertising. Similar procedures as aforementioned in photo-illustration are used, only background and other "furnishings" are added to provide aesthetic value. Attempt is made at producing a realistic setting similar to that in which the final product will be utilized. Cougars, falcons, and appropriately attired human females are familiar inclusions in automotive product photography.

Photodrawings

As the name implies, a photodrawing is simply a composite of a photograph and a drawing which facilitates the reduction of drafting time and supplements conventional drawings. Their use assists in conveying dimensions, positions, identification and spatial relationships much the same as a technical drawing.

Photodrawings can be of two types. They can illustrate existing installations and show, through the addition of line work, the changes which are to be made, thus eliminating complex and expensive drawings. They can also be photoreproductions of drawings from which undesired material has been cut or opaqued. Using these reproductions, the draftsperson can complete the addition or new design feature without having to redraw or trace previously prepared work. Technical pens are used to draw on the black and white photographic prints or photosensitive drafting medium.

Microfilm

The real potential of photographic technology lies in its use as a working tool with active information. Microfilm has become an absolute necessity in many industries because of its economical advantages, especially as applied to drawing filing and retrieval systems, not to mention time and space savings. Microfilm is available in 16mm, 35mm, 70mm and 105mm sizes, although 81 percent of those corporations using microfilm use the 35mm format. We have found that High Contrast Copy film produces the best results and the drawing, preferrably inked, can be photographed on the copy stand or taped to a vertical surface and photographed by a tripod-mounted camera. Printing can be done using a regular photographic enlarger, a microfilm reader-printer or a standard slide projector by projecting the image on fast diago print paper.

Scissors Drafting

This technique, called cut and paste, scissors and paste or just scissors drafting, is used when a few parts of an existing drawing are to be removed so that either a revised or new drawing can be created by adding the appropriate new drafting.

Paste-up Drafting

Although similar to scissors drafting, paste-up drafting provides a means of using existing materials to create drawings without hand copying. Developed to its full potential, this technique can be used to provide a dramatic increase in drafting productivity. The amount of hand drafting required to complete drawings can be reduced to a minimum by achieving as high a degree of standardization as possible and by utilizing such aids as a typewriter or mechanical lettering equipment. The use of "magic" tape on the back side of the original drawing produces a minimum amount of ghosting when reproduction is done by the diazo process.

Drawing Restoration

Documents which have become worn, faded, deliberately erased, charred by fire, water soaked or damaged in some other way can often be restored economically through photographic processes. By using contact or projection printing, smudges and stains can be eliminated, weak lines strengthened, and an excellent reproducible copy obtained upon which new or additional drafting can be conducted.

SUMMARY

I would like to ask you to consider the present state of the art in technical drawing. What are the existing trends in industrial drafting? What are things going to be like in the field in 1985-1990? Are we teaching what drafting has been or are we attempting to project our curricular efforts toward what will be? Remember, the greatest contribution to obsolescence is satisfaction with the status quo.

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Putting Field Work and Mapping into the Industrial Education Program for About 50 Dollars

Edwin W. Siefert

Every person at some time, and perhaps frequently, must depend on information contained on maps. Everyone of us here has used a map, perhaps enroute to this convention. Maps are important to us. Unfortunately, although we are aware of the importance of maps, we fail to include the subject in our curriculum.

We could perform another experiment by asking when you were last taught something about maps. If this group is typical of most gatherings, the majority of replies would indicate the 5th to 7th grade range, in studying geography or government.

We find in the curriculum Machine Drawing I, II and III; and perhaps Architectural Drawing. At the most, one in every 500 trained to the level of a third drafting course will ever utilize their training. Furthermore it is a rarity that a person prepares an architectural plan that is good enough for a contractor without hiring a professional architect to finalize and prepare the plans. In the eyes of the taxpayer and in the interest of the student's welfare, we might have difficulties in justifying these offerings, while being honest with ourselves.

I advocate reducing the number of courses in specialized drafting areas unless you are teaching in a combination vocational and conprehensive high school situation. An alternative would be to offer experiences to satisfy the elementary and secondary exploratory learning objectives. Time will only permit me to elaborate on one such area of experiences — mapping. Mapping is omitted often from industrial education programs. This presentation will first define mapping, then give some supporting information concerning the need for this subject, discuss the financial investment, describe representative field jobs that can be performed with inexpensive equipment, suggest some possible classroom study and activities, and enumerate some selected sources for instructor help.

DEFINITION

Mapping, as defined by Webster, is "to delineate as on a map; also to explore, survey, etc. in getting data for a map." A synonym to the combined operations is "Topography." Webster defined topography as "the art or practice of graphic and exact delineation in minute detail, usually on maps or charts, of physical features of any place or region. The configuration of a surface, including its relief, the position of its streams, lakes, roads, cities, etc."

To fulfill the meaning of the definition will entail several operations — namely: a. Acquiring field data, b. note reduction, c. obtaining other related information and d. mapping.

INTERESTING SUBJECT TO TEACH

A forward-looking industrial education teacher will be quick to note that the first of the listing would involve students in outside activities. The second and third listing would encompass such subjects as mathematics, geography, government, etc. whereby guests, team teaching and field trips may be appropriate class considerations. The fourth item on the list could involve students individually or in teams to compile and convert data into the graphic language of maps in the drawing classroom.

This subject has such varied activities that it is never boring for the most restless students. Problem students will be a thing of the past because you can set up the program to involve parents and their property, work with community leaders and actually do projects of value in the area.

Such a statement reminds me of the late August Schultz, who was one of my practice teachers. Prior to receiving the class, we were warned that this group was full of trouble makers and thrived on creating problems for teachers in the school system. The first few days were tough but, would you believe, before the fourth week I had heard the principal and others asking what Mr. Schultz was doing to get these boys so interested and involved. One parent at a Lions Club meeting mentioned he couldn't understand his son's change of attitude toward homework in his shop mapping program. The son was now asking for help in understanding his property descriptions and offered to assist in locating additions the father planned to make around the home. The answer was simple; the boy was learning ways to become involved in meaningful activities with adults.

You too can enjoy the fun, enthusiasm and interest this subject affords at very little school expense and effort on your part. What student (and teacher too) would not want to be outside when the weather permits rather than be confined to the conventional classroom?

OCCUPATIONAL NEEDS FOR THIS TYPE OF PROGRAM

In addition to providing exploratory opportunities to the students, a basic course can involve field experiences sufficient to make your learners attractive as potential aides

and helpers. Such people are in demand by local professional surveyors and topographic field engineers.

From what I have heard at various meetings, read in our professional bulletins and observed in personal inquiries received, there is and has been an extreme shortage of persons with some background training, experience and knowledge to obtain field data and make the maps. The helper situation is being somewhat relieved through vocational training, but it is slow. There is no reason why some help cannot come from the secondary schools where students are able to develop familiarity with procedures.

The pinch was felt more than 10 years ago, and the situation is still tight. A report from the Wisconsin State Highway Commission then stated they were employing more than 600 engineering aides and technicians and expected it to increase 50 percent over the future years. Their normal turnover is about 10 percent per year.

An appeal quote from the National Surveying and Mapping Magazine stated, "There is a large reservoir of untapped manpower which, if given some guidance, basic training and education, will be able to perform creditably." The words "perform creditably" should strike the secondary industrial education teacher and administrator because these words in themselves reveal a willingness on the part of the skilled to accept one or two on each team with the slightest of knowledge.

The shortage is not restricted to Wisconsin. In those states of great land growth and demands, i.e., Florida, Ozark area, Canada, etc., real estate development, oil wells and lines, condominium type retirements, etc., all have added greatly to make the shortage more noticeable. As an example, Florida called on the Society of Professional Land Surveyors for help. As stated in the August 1970 issue of Engineering Graphics in the article, "Expertise and Experience on the Way," the society conducted career days in high schools hoping to bring more learners into the occupation. In early 1971, the society went still further by establishing a scouting merit badge program lasting four Saturdays in which basic information and practice is experienced. Several high schools have since started programs in Florida.

New York State experienced shortages similar to Florida. Several high schools now have programs in that state. There is an exceptionally good course outline and training program in effect at the Niagara-Wheatfield High School in Sanborn, N.Y. I have had considerable association with the teacher of this course, and the program looks good to me.

Because of recent state land laws and the demands from oil line firms and Department of Natural Resources for Flood Controls, Wisconsin is going to remain in a critical stage for some time to come; I am certain other states can be classified similarly, because most state requirements are the end result of National Environmental Protection Emergency Acts. Several years ago the University of Wisconsin-Stout was asked either to lend assistance directly or to help in vocational preparation. Today at Stout we teach topography on campus and have a Mapping Institute summer camp program at Pigeon Lake Field Station during August. In the camp program, making the topographic map is the end result of obtaining field and acquatic data and then reducing the field notes to the map language for either computer or hand method drawings.

I am aware of several new high school programs initiated by teachers who attended the summer Mapping Institute. The best sample outlines were received from Si Wera, New Lisbon High School, New Lisbon, Wisc. 53950 and Eugene Traxler, Menomonie High School, Menomonie, Wisc. 54751.

For those unfamiliar with mapping or who want specific help in starting a mapping program, I would like to recommend the two or three week Mapping Institute. It is an institute where we put teachers or those of similar interests and desires into teams for training and experiences. Additional information is available from this author.

EQUIPMENT

Now that you have been exposed to some of the need for this type of program, let's talk a little bit about equipment. Invariably, you will find it more interesting to teach and the students will enjoy any program more if they can couple outdoor work with that of the classroom. Since this subject lends itself to both methods, let's assume you choose to do a little of each. An equipment list would consist of:

Commercial	Cost	Improvised	Cost
Transit	\$500-\$3000	Surveyors Cross	\$ .50
100 ft Tape	12.50-75.00	100 ft Tape	12.50
Set Marking Pins	15.00	Coat Hangers	.00
Quiver	22.50	Ring	.00
Leveling Rod	49.50	Folding Tape	2.00
Abney Level	22.50	Abney Level for Angles & Horizontal	22.50
Hand Level	18.00		
Hand Compass	4.50	Hand Compass	4.50
Field Book	1.00	Field Book	1.00
Right Angle Prism	20.00	Surveyor's Cross	.00

You can set up a good basic course involving outdoor work with a budget less than 50 dollars (as noted above) or you can go to extremes involving hundreds or thousands of dollars. It is nice to be realistic, but more important is how the information is presented. Has the student been exposed enough through exercises to understand the fundamental procedures and processes and apply knowledge to realistic situations?

Although transits are available as surplus property from time to time (maybe your school already has one), a transit is not necessary to teach fundamental operations that an aide or helper would need to know if working on a job. This is the level where your students would begin in employment.

Should you not be familiar with duties, responsibilities and training needs for persons in the surveying and mapping areas, I would recommend the pamphlet, "Civil and Highway Technology," No. OE-80018, U.S. Department of Health, Education and Welfare, Washington, D.C. This pamphlet outlines job descriptions and requirements, and also suggests techniques for determining courses of study in vocational-technical education programs. Familiarity with these occupational duties may be a help in your high school industrial education classes.

Inexpensive equipment for a basic program may include the surveyor's cross as a convenient substitute for the transit in horizontal measures, a hand compass with a magnetic needle to locate north, a 50- or 100-ft cloth or plastic tape for direct measures and marking pins made of coat hangers. If any form of elevation is desired, the Abney hand level is suggested over the Locke hand level. The few additional dollars in cost will enable the measuring of angles as well as distances on a horizontal plane. A 6-ft folding rule serves as a good substitute for the leveling rod, as does a replacement tape attached to a board. These alternatives provide a considerable savings in cost.

Since the surveyor's cross becomes such an important tool, let me elaborate on its construction. A broomstick handle pointed on one end becomes the tripod. A piece of plywood, exterior type, is the base for mounting the graduated plate. The graduated plate is easily made by xeroxing a 360-degree plastic protractor. The sighting needle is made from a tin can with the ends tapered and turned up for closer measures. The brads at 90 degrees are used for rapid perpendicular locations to a base transit line similar in use to the right-angled prism.

Relative to the availability of inexpensive prefabricated facsimile equipment, Mr. Leonard Valore, Executive Director, North American Correspondence School of Surveying and Mapping, 4500 Campus Drive, Newport, Calif. 92660, referred me to their supplier, the American Basic Science Club, 104 Heiman Avenue, San Antonio, Tex. 87205. Unfortunately, I have been unable to receive a single set from them. The primary reason is believed to be the quantity desired, as they are made specially for the correspondence school.

TYPICAL FIELD JOBS WITH INEXPENSIVE EQUIPMENT

The only field work that cannot be performed on actual jobs (of course, not meaning legal work of any kind) would be those involving stadia or elevations requiring higher order accuracy. Some of the field exercises and practices I suggest to teachers of elementary or basic training are:

a. Setting up a triangular course whereby the angles are measured with the surveyor's cross, then check angles and correct for errors.

b. Tape between two distant points to learn the taping procedure, practice using marking pins and applying tension to tape. Then learn to calibrate a walking pace.
c. Measure a staked closed traverse, plot it on paper, and compute the enclosed area. Methods of field notes and accuracy of workmanship of the various methods are stressed in this lesson.
d. Determining height, grade and slopes, etc. This exercise involves the shadow tip method, boy scout, or eyeball method, and then the Abney level or trigonometric method for check.
e. Indirect measuring of distances (similar to stadia) but by methods of speeds in comparison to known distances, or pacing, etc.
f. Finding north by method of watch, shadow-tip, or starts (Polaris).
g. Measuring and planning a garden plot using angles and distances.
h. With surveyor's cross, measure or stake a cul-de-sac.
i. Stake out a parcel of land as read from an abstract.
j. Stake out the foundation for a school sign.
k. Taking topog of a city square, park, etc., using the surveyor's cross triangulation method, the base line method, and the army chain method.
l. Stake out a ball diamond, tennis court, volley ball court, etc., on the school grounds with Abney level for elevations and the surv or's cross and tape for corner locations.
m. Measure the school forest, estimate lumber, etc.

CLASSROOM STUDY AND EXERCISES

Although many of the outside jobs can be completed in the classroom or used in connection with a study guide or worksheets, there are other ways that a student can continue his learning by doing in this subject.

a. Do some armchair surveying by making dimensioned plats of parcels from abstracts in which the terminology includes chains, links, etc.
b. Locate oneself on a map by means of a compass.
c. Read various types of maps.
d. The Army Corp of Engineers has tapes for loan. I recall one by commentator Edward R. Murrow where he describes the path of a bomber traveling from Greenland to Texas making stops en-route. This can be an interesting multi-subject lesson by having the student plot the travel on a North America commercial map (geography-drawing) as he hears the tape. Then determine time zones, solve (math) for the bomber speeds, gas consumption and the like.
e. Read road maps.
f. Locate properties with a platbook and write descriptions.
g. Study deeds and abstracts obtained from parents and then compare with a trip to Registrar of Deeds Office

Classroom study topics, assignments and reports can include numerous units that would be most interesting and worthwhile. Among such related items may be:

a. Earth's magnetism, dip and declinations
b. Planetary relations of the earth
c. History of land descriptions
d. Types of map projections, i.e., conical, cylindrical, mercator, and others
e. Investigation into the specific types of surveying, i.e., construction, land, structural, aquatic, and others
f. Types of maps; maybe a project could involve making a scrapbook of the various types
g. Earthwork calculations for areas and volumes; possibly determine how many yards of earth were removed for a new building basement somewhere near school
h. Determining time, speed, etc., via solar methods

SOURCES FOR HELP

It is the policy of the University of Wisconsin-Stout to offer any help possible by means of referrals, sources of information, references and the like. The Graphic Communications Department will provide these services relative to field work and mapping. If you feel a lack of skills and knowledge in field work and mapping contact Stout before Thanksgiving to be assured of topography being on the summer school program. However, if you can solicit about 10 to 15 students before May, it is certain that special arrangements could be made to meet your needs.

Stout conducts the annual Mapping Institute during August at Pigeon Lake Camp in Northern Wisconsin. No prerequisites are necessary for this 2 or 3 S.H. graduate or undergraduate program. If you have interest in this program or desire to be placed on the brochure mailing list, contact the University of Wisconsin-Stout.

Films are available from many sources. Some are free films and others are rental. I use a card index of their availability, so feel free to drop me a line stating your particular interest and I will reply as to what I have.

County officials from such departments as Soil Conservation, Highway, Registrar of Deeds, and the like are all very cooperative if asked. Also, do not hesitate to ask any local surveyors to present lessons or demonstrate their more elaborate equipment.

CONCLUSION

I hope I have stirred an interest and desire for a new avenue of study in your present industrial education programs. Remember, students like to be outside to learn by doing, just as you do. If you want summer employment (as many teachers must), having a little basic knowledge is good and often amply satisfies local, county and state officials' needs. Summer jobs in surveying and mapping are plentiful.

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Interdisciplinary Studies

Implementing Technology-Based Programs in the Public School

John M. Ritz, Frank R. Trocki and John R. Wright

Industrial education has changed its content emphasis several times during the past 100 years. Early programs concentrated on tool skill development and creative design. Combinations of the Russian, Sloyd and English crafts movements made up the core of what was taught in manual training and manual arts through the turn of the century.

Influenced by the manual training movement which was popular at the turn of the century, industrial education continued its emphasis on pre-vocational skill development. Following the call for a name change to industrial arts by Charles Richards in 1904, new directions, emphasis and definitions were developed which marked the beginning of a dichotomy in industrial education.

In 1917 the Smith-Hughs Act caused a philosophical split in industrial education which transformed the dichotomy of ideas and words into reality. At this time there existed two basic views about industrial education: The study of occupational skills (vocational education) and the study of industry (industrial arts). The occupational skills view:

> ...identified itself with the standards movement and rallied behind the findings and interpretations of the American Vocational Association's Committee on Standards and the twenty-fifth anniversary publication of the Manual Arts Conference. (Sredl, 1966b, p.41)
>
> The second interpretation championed the liberal view of the curriculum area, stressing the study of industrial arts through the analysis of industry as opposed to the analysis of trades. (Sredl, 1966b, p.42)

Significant events that promoted the cause of those who agreed with the vocational philosophy were World Wars I and II. During that period three major emphases were practiced in industrial education. These included:

1. Vocational skill development
2. Arts and crafts skills
3. Interpretation of industry

In 1947 a trichotomy was created which marked the beginning of programs based on the study of technology. Under the leadership of William E. Warner, a new proposal was set forth which called for the study of technology in industrial arts. The new proposal, titled "A Curriculum to Reflect Technology," was aimed at general education with its content derived from the socio-economic analysis of technology. (Sredl, 1966c, p.52)

During the fifties most programs in industrial education continued the emphasis of previous years, and the major ingredients of industrial education consisted of industrial or occupational variations. However, in 1957 a significant forward movement was accomplished for the technology approach by Delmar Olson. Olson's research, "Industrial Arts and Technology," provided the foundation for many of the programs which were developed during the sixties in both technology and industry versions of curriculum development.

The decade of the sixties is the most difficult period in our history of industrial education to analyze and classify. Many of the industrial arts programs that were developed during this era were spin-offs of the Sputnik influence and increased federal spending for curriculum development. Industrial arts programs began to include the study of industrial technology, or occupational information and skill preparation. The distinction between vocational education and industrial arts became a major concern and is reflected by the guides and position papers developed by the American Vocational Association and the American Industrial Arts Association.

Programs such as the Maryland Plan, the American Industry Project and the Industrial Arts Curriculum Project represent the industrial arts philosophy best because their major emphasis is on the study and analysis of industry.

Programs such as the Richmond Plan and the Galaxy Plan were more occupationally oriented and reflected the vocational concerns of emphasizing the world of work and career preparation.

The technology-based programs also began to change with more concern for the social/cultural aspects of technology and their effect on man. Proposals such as Man and Technology as a Structure for Industrial Arts and the Texas Industrial Arts Curriculum study represent the concern for the study of technology well.

In 1970 the American Industrial Arts Association conducted its annual convention in Louisville, Ky. As evidenced by the convention's proceedings, a number of industrial arts educators such as DeVore, Lauda, Ryan, and others called for the inclusion of the social/cultural aspects of technology.

Research and development was promoted at West Virginia University to explore the discipline base of industrial arts. A new curriculum was developed from the discipline base of technology and in 1973 the name technology education was approved to replace the industrial arts title. Continuing research is presently being conducted at both the university and public school level in an effort to further develop technology-based programs.

Also reflecting the interest in the social/cultural technology-based program are the present efforts at Eastern Illinois University and Fitchburg State College. Both programs are presently in the process of developing and testing curriculum derived from the discipline base of technology.

As shown by this capsule review and historical time-line, the field of industrial education is diverse and appears to be rooted in three philosoohical positions. Of interest here is the heritage and development of technology-based programs.

A RATIONALE FOR THE STUDY OF TECHNOLOGY

While reviewing the historical development of industrial education, questions often arise concerning the content source or reservoir of knowledge from which teachable content should be derived for study in industrial arts. Eminent members of the profession have voiced their philosophies during the past decades emphasixing that the content for industrial arts should be based on the study of occupational skills, industry, materials and processes, and technology. In an attempt to clarify why a number of members of the profession feel that the content for the study of industrial arts should be based upon

technology, the following rationales will be viewed and discussed. They are attempts to provide reasons for utilizing technology as a basis for establishing industrial arts programs.

Since the dawn of history, man has always lived in a technological environment. This is evidenced by the fact that his life and culture have in some ways been dependent upon technology. Man has made tools to build his shelters, produce his food, manufacture his clothing, transport his belongings and communicate to his fellow man. According to Melvin Kranzberg, we find that technology has been the basis for all human activity throughout history. (Kranzberg, 1964, p.1) Man, without technology, could not have progressed into the eras of agriculture, crafts, industry, power and now a post-industrial society. In order for us to understand past and future civilizations, Kranzberg feels that technology should be studied in the general education curriculum.

A leader in our profession, Delmar Olson, succinctly voices his rationale for the study of technology in the industrial arts curriculum. He states:

> Industrial arts has traditionally been a disciplinary subject, in that it insisted on routing a youngster through a series of prescribed experiences leading to a mastery of a tool or machine tool under the assumption that this mastery was the essence of its goodness. It seems to me that it is time for us to reconsider what the mastering of materials, energies, tools, machines, and products by man has done for him; to reflect on the control he has created for himself over his natural environment; and to look at the environment he is creating out of this mastery as the source of its subject matter. In my opinion all of this stands as a challenge; it is the challenge of technology and the great mission for industrial arts. With this kind of industrial arts, man can learn about this material mastery as he discovers and develops his own native aptitudes for having better ideas with materials. He can find value in his technology beyond that of tool skills and can gain an ever greater control of what happens to him in his time. (Olson, 1963, p. v)

From this it appears that Olson is saying that the study of technology in industrial arts can offer much more than a mastery of tools and materials. If properly studied, it allows the student the opportunity to interact and possibly control his future destiny in a society that is technologically oriented.

Another proponent for the study of technology is Paul DeVore. In his monograph, Structure and Content Foundations for Curriculum Development, he stated that, "The understanding and comprehension of technology are important in fulfilling a fundamental objective of education, namely, understanding the culture." (DeVore, 1968, p.3) It appears to be a widely held belief that our society is based upon technology. Eminent sociologists and technologists such as Mumford, Ellul, Singer, Drucker and Toffler also hold this view.

DeVore continues his development of a rationale for the study of technology by stating:

> ...if we accept as valid the assumption that education is integrally related to the culture of each (historical) period, we must assume that a society whose base is technological and scientific will reflect, in some measure, the technology in the curriculum of its schools. (DeVore, 1968, p.2)

From this, DeVore proposes that an industrial arts curriculum should be based upon the study of man and technology which:

> 1. Provides a better base from which to implement the purposes and objectives of general education;
> 2. Is not limited and isolated by geographical boundaries, thereby evidencing the true nature of disciplined inquiry;
> 3. Is concerned with man as a creator of technology regardless of natural origin;
> 4. Provides a meaningful relation between technology and man's culture. Historical, anthropological, social and economic elements of the culture are important to the understanding of man's technology. A knowledge of man's technology is vital in understanding any culture; and
> 5. Identifies a knowledge area meeting the criterion of a discipline in the truest sense of the term. (DeVore, 1968, p.2)

In summary, DeVore presents the view that technology is at the base of our society and culture. If one is to function efficiently in a technological society, he must be in tune with the technology around him.

Robert Ryan further points out why the study of technology education should replace industrial arts in the school curriculum. In his presentation at the 1970 American Industrial Arts Association convention, Ryan points out that the majority of today's students are not interested in the study of industry. They are crusading for a variety of causes, most of which are based upon the uncontrolled technology within our environment. He further states that the students:

> ...Are trying to understand the world we live in and why there are problems. You will agree that many of the dilemmas today are caused by technology and its related factors. Therefore, if youth today do not develop a technical literacy, there will be continued alienation from technology. What we must do, then, is to introduce them to technology, its many facets, and to key issues of today's society. (Ryan, 1970, p.200)

As can be seen, this is another viewpoint for the study of technology. Although it focuses on different reasons, it can still be held as a valid rationale for replacing the study of industry by technology.

Don Lauda furthers the need to study man and technology in general education. He states:

> One can safely assume that the graduating high school student does not understand his technological society. There is not a single discipline that is making a conscious effort to interpret or to help the student interpret his technological culture. (Lauda, 1970, p.198)

In the future, our students must cope with their manufactured technological society. If they are to be in control of their futures, they need to be attuned with the technology that changes their society. Lauda feels that industrial arts is the curriculum area where this training should take place.

An additional futuristic view that is arising as a rationale for the study of technology relates to the economic development of mankind. Our society is quickly entering into a post-industrial era. The post-industrial society is a state of new mentality or, as stated by Bell:

> The post-industrial concept is an effort to identify crucial structural trends in the society—trends in the economic, technological and occupational pictures and in the source of innovation in society. (Bell, 1974, p.18)

This stage in our societal development began in 1956. In that year more of our work force was involved in service-producing than in goods-producing. (Chase, 1973, p. 296) In short, our work force was suddenly comprised of more white collar than blue collar workers. Our old industrial order had passed, and a new society had emerged. It was from this shift that Bell, Kahn, McHale and others developed their foresights.

One conception of the post-industrial society identifies five major attributes that can be found within this society. These include:

1. The change from a goods-producing to a service economy
2. The pre-eminence of the professional and technical class in the society
3. The centrality of theoretical knowledge as the source of innovation and policy formulation in the society
4. The creation of a new "intellectual technology"
5. The possibility of a self-sustaining technological growth (Bell, 1974, p. 18)

The society of the future will no longer be based uoon an industrial economy as in the past. An identifiable developmental stage has emerged which is similar to the transition made by our society when it progressed from an agricultural to an industrial era. Since industry will no longer be the basis of our economy in the post-industrial society, it should not be heavily studied in the general education curricula. In its place, man will need to study technology. This new shift should prove equivalent to the decline in the study of agriculture after our society progressed into an industrial era.

Because the post-industrial society is based on the employment of advanced technology, it will become an increasingly important area of study in the school curricula. When implemented, the study of technology will enable man to understand his society and control those situations which will have impacts on future civilizations.

In summary, it is hoped that the above discussions provided a number of rationales for employing technology as the content base for the study of industrial arts. Following is an explanation discussing how the discipline of technology can be used to structure classroom programs in industrial arts or technology education.

STRUCTURE AND CONTENT OF THE TECHNOLOGIES

In an attempt to develop a meaningful industrial arts program, man's major areas of knowledge must be first considered. These areas of knowledge include the sciences, humanities and technologies. These areas of knowledge are also referred to by some as the major disciplines of knowledge. These are definite interrelationships that exist between the three areas of knowledge. The study of technology should be also related, in those connected areas, to the sciences and humanities.

The major area of knowledge from which industrial arts draws its content is technology. Rex Nelson, in his 1970 presentation at the AIAA convention, divided technology into four major subclassifications. (Nelson, 1970, p. 110) These included natural technology, physical technology, psychic technology and social technology. In industrial arts the physical technology would be used in structuring a curriculum. These include "man's purposeful pursuit of change in that part of the environment which includes purely physical, including man-made, factors." (Nelson, 1970, p. 110) A definition which assists in explaining the physical technologies is provided by Henry Skolimowski. He defines technology as:

> 1. The totality of all man-made tools; or
> 2. The totality of all man-made tools and their function and use; or
> 3. The totality of all man-made tools, their function and use, and the material results of their application (technological products); or
> 4. The totality of all man-made tools, their function and use, the material results of their application (technological products), and the social impacts of their products; or
> 5. The totality of all man-made tools, their function and use, the material results of their application (technological products), the social impact of these products and the influence of technological change on the life of particular individuals and societies and groups. (Skolimowski, 1970, p. 35)

Industrial arts teachers have presented a somewhat adequate view of the physical areas, teaching about tools, processes and materials. Very rarely has an attempt been made to present the areas which are necessary for the student to envision the whole system, including the development, need for, and impact of tools upon man and society. Simply stated, there would be no technology (tools) if there were no society. There would have been no Industrial Revolution or development of mechanized tools if there were no scientists researching and developing innovative techniques. There would be no need to study technology today if there were no stresses or future shocks confronting man and society. The displacement of humans due to the development and introduction of automation and cybernation has created this change and awareness.

The relationships and implications of technology on man and society could possibly be listed indefinitely, leading to higher levels of complexity. These developments would introduce other concerns such as morals, values and, of prime importance, man's ability to control technology.

Industrial arts teachers should make an attempt to understand, comprehend and relate to their students the areas dealing with the physical technologies and their relationship to the sciences and humanities. This is of critical concern to the development of future man and society. As related by Paul DeVore:

> Each and every citizen must attain the proper comprehension of the whole process of advancing technology, and understanding of our technical strength and the role each citizen must play in order to retain and advance our culture. (DeVore, 1964, p. 80)

THE PHYSICAL TECHNOLOGIES

To this point, man's areas of knowledge and the physical technologies have been discussed. From here, it is appropriate to illustrate what is meant by the physical technologies, including the structure and content.

Paul DeVore has identified three subdivisions of the physical technologies in his study of technology education at West Virginia University. These areas are communications, production and transportation.

These three areas are defined by the authors as follows:

Communications Technology — the study of the processes, methods and effects by which information is mediated, socially, psychologically and physically, through man's environment.

Production Technology — the study of the methods and processes used in the output of goods, services and information possessing an economic value.

Transportation Technology — the study of the methods, processes and implications of moving goods, services and people from one point to another.

Definitions by themselves offer no real value unless accompanied by some sort of organization which describes the possible content of the discipline. To accomplish this, a taxonometric structure has been chosen to present this information. A taxonomy is not to be considered a curriculum. Its purpose is to classify and structure the knowledge and relationships of the discipline being investigated.

> A (taxonometric) structure is a tool used in curriculum development. A discipline structure does not classify instructional methods, materials or behavior changes expected in students. (DeVore, 1968, p. 11)

On the other hand, it does attempt to represent the whole picture of the discipline. The curriculum designer may use this structure as a reference or cookbook to help guide him in developing the content for his courses, noting relationships and key concepts.

It is in this manner that the authors approach the problem of curriculum development. The first step is to identify the total spectrum of the discipline. This practice is one which many teachers, as curriculum developers, do not employ. Usually they choose a small section of the whole discipline and attack only that portion. It is like starting a race at the half way point on the race track, instead of at the starting gate, thus leading to a specialized curriculum in a general education setting.

Keeping this last thought in mind, let us examine a taxonomy in communications technology. Upon analysis, several assumptions can be made:

> 1. Each category is identified by a word or a phrase which delimits the category but is nontransient and permits additions to the structure as discoveries of new knowledge warrant.
> 2. There is a relatively small number of mutually exclusive groups or categories.
> 3. The distinction between groups or categories is established by a universal concept inherent in the knowledge area itself.
> 4. There is evidence of external stability with internal flexibility and adaptability to evolving new knowledge within the discipline.
> 5. The information presented is not limited to local or national knowledge areas but is international in scope.
> 6. Categories or clusters are established wherein each larger unit is a combination of subgroups. The groups or categories are established in a hierarchial order. (DeVore, 1968, p.9)

The last assumption has the most remifications for curriculum design. It identifies the structure as proceeding in a direction from the general to the specific content. A widely practiced contradiction of this assumption is illustrated by the course offering of graphic arts. Graphics is only one of five channels used in communication. (The others are electrical, electromagnetic, mechanical and fluid.) The structuring of a course around the specific area of graphics ignores the significance of four other channels of communication. By doing this, the content of the courses in graphic arts is very limited in scope. This introduces the student, who is supposed to be in general education, to a very specific, if not pre-vocational, type of course. What about the other channels; should they be considered? Should the other major categories be included?

It is the authors' belief that they should be integrated and related. By doing this, the industrial arts teachers would be able to get back on the track of providing a general

education to students, not an occupational, pre-vocational, or vocational program which is too specific and limited for a future that is full of technological and social change.

It is time for industrial arts teachers to examine the whole of the disciplines of communications, transportation and production technologies, not just in small segments such as graphic arts, woodworking, or metal working which may be too specific for general education.

In conclusion, it is our view that industrial arts programs based on the study of man, society and technology would develop students with the ability to cope with and comprehend our complex technological society. It would provide finally an identity and position for industrial arts teachers in the educational structure — general education — not specialized education.

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Industrial Arts: Its Relevance to the Practice of Medicine in America

Rick Coger

A great problem confronts one who writes on the relevance of industrial arts to the practice of medicine. One has to speculate whether this relevance began with people, a chain of events, from a series of needs or others.

Historically, industrial practices and processes were used in the practice and support of the medical field. Even though this paper is concerned with the industrial processes used in the practice of medicine in America, it may interest you that industrialists played a vital role in the practice of medicine in China during the T'ang Dynasty (619-907 A.D.). Women of social status in China never exposed their bodies to physicians. It was considered to be immodest for a lady to do such. They commissioned industrialists to design and develop statuettes of themselves. These statuettes were made of ivory or alabaster. Instead of submitting themselves to physical examinations, they marked the spot or spots on the statuettes where the pain was believed to be located in their bodies. The physician used this piece of information in making a diagnosis for treatment.

The first Americans, the American Indians, were extremely sensitive to the beauties of nature and the perfection of the universe. Life and all its mysteries were associated in their mind with a number of gods, each looking after a particular domain. The first Americans felt that every act of their lives was watched over by some supernatural power.

The first Americans were not idolaters and did not worship graven images; yet, all their possessions had some divine association. Their spoons or bowls were dedicated to a god. Death to them was only a normal occurrence in war, in accidents and in old age. Diseases were caused by anger of the higher gods or by the bad humor of some of the lesser gods. These persecuting gods were appeased by the medicine man. The medicine man was chosen, often through a miraculous dream, to study the habits of the gods. He had an intimate relation with these gods.

The word "medicine" had a different meaning to the first Americans than it has to most of us. We usually consider medicine as a drug or an herb. To the Indians, medicine included anything that might have a therapeutic significance. It could be a stone, an arrow, a pipe or the finger of a slain foe. When the American Indians referred to "making their medicine," inherent therein was an industrial process. The medicine most likely was an arrow, a stone or a pipe. These objects were made by the individual or members of the tribe.

The medicine man appreciated good craftsmanship because his paraphernalia included necklaces, a variety of charms, masks, effigies, rattles, amulets and circlets. These objects, representing a wizard-like craftsmanship, were believed to have a definite therapeutic value. Medicine had a philosophical base with nature, depending on vocational education as its foundation.

Among the various remedies employed for reducing fever was a concoction of willow bark (the original source of salicylic acid). To induce vomiting, a concoction of holly was used. Woulds were packed with the scraping from the inside of freshly tanned hides to promote healing. Splints for fractures were made of rawhide.

Today, certain materials are just as important to the field of medicine as to the industrialist. For example, examine the kinds of materials used to design and develop orthopedic appliances. Some materials that are common to both industry and orthopedics are leather, steel, rubber, adhesives, plaster of paris, fabrics, wood and aluminum.

Some usages of these materials in developing orthopedic appliances are:

I. LEATHER

kinds of leather	some typical usages
A. calfskin	to cover back braces, feet and wooden legs.
B. cattle hide	to cover back braces and corsets, to mold prosthetic appliance soles, heels and built-up shoes.
C. horsehide	lining for corsets, braces and covering for prosthetic appliances.

II. STEEL

A. for braces	brace uprights, joints, bands, splints and back supports
B. for artificial limbs	joints, hip bands and assemblies
C. for surgical application . .	surgical instruments, sterilizing units, bone plates and screws

III. ALUMINUM

Certain prefabricated parts of artificial limbs and crutches

IV. RUBBER

Form rubber for padding, sponge, thread, tapes, tubing, hose, gaskets and gloves

V. PLASTICS

A. Thermoplastic	
1. Acrylics	braces
2. Vinyls	gloves and cosmetics for hands and legs
3. Cellulosics	splints
B. Thermosetting	
1. Nylon	body support
2. Phenolics	plaster mold and for appliances
3. Polyesters	weight-bearing appliances

VI. ADHESIVES

A. Synthetic Resins	
1. Thermoplastic	used in many orthopedic ways
2. Thermosetting	appliances
B. Rubber Base	
C. Protein	
1. Animal	
2. Vegetable	

VII. PLASTER OF PARIS

Plaster bandage or cast

VIII. FABRICS

A. Cotton, rayon, nylon . . . . vinyon, silk and wool	used as protective padding in braces and splints, cushioning in cast, in straps and support, and as a base for impregnations of resins for constructing appliances.

IX. WOOD

Principal woods used for orthopedic appliances are deciduous (hardwoods or broad-leaved) trees. Some are willow, basswood, maple, hickory, oak and elm	for artificial limbs, crutches, canes, splints, shoe lifts and fracture equipment

Tools and machines commonly used to manufacture orthopedic appliances are as varied as American industry itself. They are also common to those found in many industrial arts laboratories.

In the area of rehabilitation, industry is paramount. The Journal of Rehabilitation points this out in each edition in the form of advertisements and articles. In this journal you may learn about the design, development and utilization of such items as clip board lap trays, wheel chairs, electric book-page turners and a host of other products made by industrialists for patient care.

Some other journals which depict the value of industry to medicine are: Nursing Times, Nursing, Journal of Practical Nursing, Psychiatry Digest, Military Medicine and others.

Hand tools similar to those used in industry have long been used in the practice of medicine. Amputation was practiced by primitive peoples, and some archeologists think it has been in use at least since Neolithic times. Neolithic knoves and saws of stone and bone have been found. The presence in the skeletons of the period of what look like amputated bone stumps suggests that this may have been one of the uses of these instruments.

Whatever the intent of such amputations — for magic, ritual sacrifice, punishment or the cure of disease — their advent created not only the need of a substitute, but also made the ancient physician seek their corollary, instruments. Saws, surgical knives and later artery forceps became necessary.

Celsus, in the first century A.D., describes the practice of amputation using a knife and saw. Various models of straight knives existed through the centuries, sometimes with the cutting edge concave, sometimes convex.

Some typical instruments used in the removal of costal cartilages are chisel, curved gouge chisel, straight gouge chisel, mallet, undermining knife, bone-cutting forceps, catilage shears, gigli saw and handles, bone holding forceps, angular raspatory, doyen's raspatory, pointed periosteal elevator, and periosteal elevator.

Instruments for bone grafting are broad chisel, gouge, osteotome, cutting forceps, mallet, saw, curved rongeur, straight, double hinged rongeur, holding forceps, periosteal elevator, double counter rotary saw, and bone drill.

Some representative instruments for a face-lift are bard-packer knife #15, bard-packer knife #12, hemostat, small sharp-pointed scissors, narrow, blunt-end curved scissors, short blunt-end curved scissors, long blunt-end curved scissors, skin clip, plain curved tissue forceps, curved mouse-tooth tissue forceps, mouse-tooth tissue forceps, needle holder, straight measuring instrument, narrow rake retractor, wide rake retractor and skin hook.

OCCUPATIONAL THERAPY FOR PSYCHIATRIC DISORDERS

Occupational therapy has demonstrated its value in treating the psychiatric patient. It is used as a means of making patients interested in their environment and occupying the patients' minds so they could be distracted from their abnormal fantasies.

There is an unwritten principle that, "The insane should never be idle." An occupation expends energy otherwise used for violence, excitement and mischief.

Physical medicine embraces the industrial process. In fact, physical medicine depends on some industrial practices as a means of treatment. If the disorder is phobic reactions, conversion hysteria, obsessive-compulsive state, manic depression, parandia, a senile disorder or other mental deficiencies, occupational therapy is generally recommended. Occupational therapists make significant contributions to the treatment of such patients as they 1. offer the patient the choice of an activity from a variety of opportunities, 2. give careful instruction in the skill necessary to perform the activities, 3. select tasks or activities within the capacity of the patient to achieve success, 4. develop wholesome work habits, 5. maintain work at the patient's highest level of efficiency, 6. correct deviant behavior, 7. encourage creativeness to complement success, 8. advance the patients to progressively more complicated tasks in accordance with their ability to perform them, and 9. develop within the patients a sense of responsibility for their own advancement and improvement.

Occupational therapy is used in pediatrics. The general aims of pediatric occupational therapy are to 1. aid in the adjustment of the child to the hospital, 2. provide controlled activities within the limitations imposed by the illness, 3. provide training or retraining of impaired functions, 4, assess the functional capacity of the child, 5. aid in the control of behavior disturbances, 6. promote healthy inter-personal relationships, and 7. create an atmosphere which provides normal developmental opportunities. Activities may include drawing, painting, pasting, cutting, modeling, hammering, needle activities, cordwork, weaving and leathercraft.

Occupational and physical therapy is a vital adjunct in the treatment of cerebral palsy, upper extremity amputees, tuberculosis, congenital heart diseases and in the geriatric area.

In summary, several industrial materials as found in I.A. laboratories are utilized in the field of medicine. Furthermore, some of the developments in the practice of medicine are directly related to industrial technology. There is a commonality of many tools, instruments and machines used in the fields of industrial arts and medicine.

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Industrial Arts and Home Economics Interdisciplinary Exploratory Activities

Lee Rice

The Devils Lake Public Schools, in cooperation with the North Dakota State Board for Vocational Education, co-sponsored a pilot project for interdisciplinary career exploration activities. The areas of industrial arts, home economics and mathematics at the eighth grade level were chosen for this project.

Teachers from these disciplines joined in a planning and writing session in the spring of 1974. They chose to call the project LIFE (Living is for Everyone). The project started in the fall of 1974 and continued through the spring of 1975.

The boys and girls in home economics and industrial arts were segregated in the traditional form and mixed into co-ed groups as each 12-week period progressed. Groups were rotated on a 3-week basis. This served as an experiment to see which approach worked the best. The co-ed approach to teaching boys and girls in both industrial arts and home economics was the best for all concerned.

The industrial arts activities were centered around McKnight's "World of Construction." Boys and girls worked together on such hands-on activities as planning and designing, estimating and figuring costs, locating property descriptions and lines, construction batter boards, using direction circles and survey equipment, stabilizing superstructures, constructing collapsible fish houses and lawn sheds, assembling electric circuits, soldering copper fittings and doing other plumbing activities, laying brick and cement block, applying finishing techniques, playing the big builder game and going on field trips.

Home economics activities dealt with buying, sewing, cooking, and measuring with metrics. Senior citizens came to the classroom to work with students with knitting, sewing, cooking, developing self awareness, calorie and nutrition planning, menu planning, food preparation, serving techniques, career planning, child care, developing employability traits, good grooming, time management, communication, machine operation and participating in field trips.

Mathematics activities reinforced all math concepts and applications which related to industrial arts and home economics. The eighth grade math students rarely used the traditional textbook. Rather, they were given activity sheets which related to various occupations or everyday problems which one may encounter.

With the adoption of the LIFE program, teachers had to work together to plan teaching units. Through open communication, teachers shared ideas, equipment and teaching methods.

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Strategies for Unified Arts: A Framework for Analysis

Jerry J. Richter

Unified arts in American schools is a growing movement. It is also a curriculum design resulting from coordinated planning of two or more teachers. But most importantly, unified arts is a teaching strategy. Teachers use it to form relationships in the minds of students between the ideas, principles and concepts of two or more subjects. They believe in unified arts because it helps solve an old and nagging problem in education — boredom!

The unified arts concept is not new. During the past 20 years or more, allied concepts included common learnings, unified studies, interdisciplinary education, core and a host of others. But unified arts is different; it is unique to the practical arts. For example, unified arts programs consist typically of industrial arts, home economics and art. Business education and music are sometimes included, though less frequently. On rare occasions, unified arts includes the academic subjects. Unified arts, then, is a curriculum resulting from coordinated planning and teaching strategies of two or more practical arts teachers. These teachers usually work as a team — the unified arts team.

Planning for a unified arts program is difficult. Designing curriculum is challenging; coordinating teachers is an unwieldy task. As a partial solution to these problems, this article presents a theoretical framework with field-tested examples, describing 12 strategies for unifying the practical arts.

Planning for a unified arts program requires answers to three important questions: (1) What content should be unified? (2) What unifying method should be used? and (3) What means will be used to evaluate for the achievement of intended outcomes? Each of these questions is examined.

SELECTING CONTENT

When teachers lay common plans across their respective subjects, they make decisions about content. What facts, concepts and principles should be related, thus unified? Why should these ideas be related? Although highly subjective, the answers to these questions should be based on the rationale and goals the unified arts team has set for itself. Such mutually agreed upon goals will provide the team with a sense of unity and direction in selecting content.

Content to be unified can be visualized with three overlapping circles representing the contents of industrial arts, home economics and art, respectively. All three subjects have something in common. For example, varnishing a cabinet, frosting a cake and glazing a statue are frequently demonstrated in each respective subject. Each teacher, while presenting his demonstration, can relate its features to those of the demonstrations of the other two teachers. Each can do so without significantly changing his or her own content or teaching style. The result is that students who attend all three classes see that coating is a protective and decorative process integral to many technologies. They get a related picture of the many applications of the technical process called coating. They get a unified view of three interrelated activities.

There will be content areas common to only two subjects. Since the goal of a unified arts approach to teaching is to improve instruction, the team must unify when it is appropriate and helpful to its common objectives. For instance, "Creative Script Writing" and "Techniques of Video Taping" were combined at Glendora High School, Glendora, Calif., to produce a single integrated program,[1] a unification of English and industrial arts.

If members of the unified arts team feel that certain content is unique to their subjects and no advantage is gained in learning performance by unifying it with other subjects, then it is best taught in traditional isolated fashion. Unifying for its own sake is pointless.

SELECTING A UNIFYING METHOD

After the unified arts team has been organized, has agreed upon common objectives and has selected content to be unified, the next task is to select one or more unifying methods. Selecting a unifying method is not a binary decision; rather, unification is a

matter of degree which the unified arts team can design. At least 12 different degrees or kinds of unification are possible. There are four types of unifiers, each capable of being employed at three varying degrees (idea, idea/time and idea/time/space).

The types of unifiers are project, theme, concept and system of concepts. These unifiers answer the question, "How specifically will two or more subjects be connected, enabling students to see their relationships?" The first type of unifier — a project — is the simplest to use. For years projects have been built in industrial arts, home economics and art, as well as in other subjects. They are the familiar physical objects which students enjoy and usually take home. But, as unifiers in a unified arts program, they have even greater potential for student learning.

A project can be used as a unifier in a fashion similar to that used by the Cabell County School System, Cox Landing, W. Va.[2] The project was a wall hanging. The objective was to demonstrate how several technologies play related roles in producing modern manufactured products. The industrial arts class built and finished the wall hanger rod and the home economics class cut and hemmed the decorative cloth. The art class designed the project in the beginning and later printed the cloth. The unified arts team concluded that the wall hanging project helped students to see relationships among the subjects.

The second unifier is a theme. It is a slightly more complex way of unifying several subjects. The Goodlettsville High School, Goodlettsville, Tenn.,[3] provided an excellent example. The objective of teachers there was to have students rebuild an imaginary old and rundown town named Wheresville. Students and teachers of nine classes planned and worked around a common theme — urban renewal.

Classes that participated in the urban renewal project included architectural drawing, business education, civics, economics, engineering drawing, English, history, typing and the World of Construction. The final results of the Wheresville urban renewal project were produced through thematically related projects and plans. Some of the activities included organizing a small engineering company, designing layouts of Wheresville, writing a narrative of Wheresville's history, conducting economic and geographical analyses and constructing a three-dimensional scale model of central downtown Wheresville. A theme unifier then is an overriding topic to which many subjects can relate. The theme usually climaxes in an event or display like the model town of Wheresville.

Still another means of forming connections in the minds of students between the facts, concepts and principles of several subjects is with a concept unifier. A concept unifier refers to a classification of ideas or things according to one or more dimensions of similarity, and is labeled with a descriptive term. The word molding, for instance, describes a group of activities which are similar because of their forming and shaping characteristics. Coating, discussed earlier, is another example of a concept unifier.

The Cecil County Public Schools[4] near Elkton, Md., uses concept unifiers. Color value and color intensity are used by teachers to establish the similarity of mixing paint in art class, blending stains in industrial arts and combining dyes in home economics. Each activity, although taught in different subjects and with different materials, demonstrates that by combining varying quantities of coloring agents, various color values and intensities result. Students remember the concepts of value and intensity long after specific mixing skills are forgotten.

Projects are physical and relatively easy to plan. Themes may be short with easy closure, but concepts are more difficult for each subject teacher to specify and compare. The fourth unifier — a system of concepts — is the most sophisticated.

A system of concepts shows the position and relationships of a number of concepts to one another. An example of a conceptual system is design, used by the Cecil County unified arts team in the middle school program. Like the other unifiers, a system of concepts can be used to tie two or more subjects together. The goal is for each teacher to demonstrate as many of the concepts as possible in his or her own content area.

In addition to teaching the usual lessons, each teacher also elaborates on which concept the lesson exemplifies. For instance, the Cecil County Unified Arts Team accomplishes this lesson as follows. While demonstrating the concept of line in good design, the art teacher demonstrates and discusses line construction and quality; the industrial arts teacher differentiates and demonstrates object, construction, dimension and center lines. Similarly, the home economics teacher demonstrates the use of three-dimensional lines, and the music teacher points out the characteristics of melody line — direction, range, rhythm and mode. By developing a conceptual system, teachers create a systematic means of unifying their subjects. Consequently, they develop for students a unified or

whole picture of what must otherwise seem like a bewildering array of dissimilar ideas and activities.

Unifiers are important. Equally important is the degree of unification. The three degrees of unification are idea, idea/time and idea/time/space. The first is typified as follows.

Suppose that within the school plant, the art room was located at one end of the building, the home economics room at the other end of the building and the industrial arts facility was in another separate building. Under these conditions, unifying the three subjects is difficult. Although teachers would not be able to unify to the strongest degree possible, they can still unify in idea.

Unifying in idea means that several teachers use the same unifier, but they do so in their own classrooms and at different times of the year. If a concept unifier were used, say the concept of color, a student taking industrial arts early in the school year would learn color characteristics of hue, value, intensity and harmony for industrial applications. When the same students took art around Christmas, they would learn about color concepts again, but this time in relation to artistic design. Finally, near the year's close they might learn about color concepts from another point of view when they take home economics. Even though the concept of color was taught in different classrooms and at different times of the year, students who took all three classes would have seen how color, though manipulated differently in different technologies, is characterized by its hue, value, tone, intensity and other universal features. In a sense, students would have revisited the concept of color in each class.

The second degree of unification — idea/time — is different. The unifiers are used around the same time of the school year. Unifying in idea and in time means that members of the unified arts team plan to use a unifier within the same short period of time, perhaps during the same week. Unifying in idea/time is possible when students study unified subjects concurrently.

The advantage of unifying in idea and in time is continuity. Students forget less because related ideas are presented to them in a small period of time.

The third degree of unification is the most sophisticated — idea/time/space. Unifying in idea, in time and in space means these teachers use the same unifier idea (project, theme, concept) within the same short period of time and in the same space. Of course, conducting several classes in one large room such as a cafeteria or gym can be unwieldy. But parts of three different classes could be unified easily in idea/time/space. The advantage is that participating students clearly see the necessary and simbiotic relationship of skills, people and ideas in the solution of real life problems such as constructing theatre sets, developing advertising displays or promoting an ecological action.

CONCLUSION: EVALUATING THE PROGRAM

The temptation for teachers to judge a completed project favorably is great. There is good reason — they have worked hard on it. Good evaluation requires a certain degree of objectivity. Evaluating unified arts programs is no different. Two types of evaluation are used — formal and informal. Both can be effective.

The Penn Manor School District, Penn Manor, Pa., has evaluated its unified arts program formally. Since the primary purpose of the program was to change attitudes in students who had become disenchanted with school, two attitude scales were used.[5] The first was a modified version of the School Sentiment Index. It was obtained from the Instructional Objectives Exchange in Los Angeles, Calif. The second, a semantic differential scale, was designed specifically for the Penn Manor Project. Both scales helped teachers determine if their goals were being met.

Evaluation need not be as rigorous as Penn Manor's to be effective. Informal checks on goal attainment also work. Quizzes, checklists and exams are helpful, as well as evaluation in terms of progress toward the behavioral goals established for the unified arts program.[6] Student behaviors, parental reactions and administrative comments are also ways of gauging the success of the program. Evaluation is never easy; outcomes are frequently mixed. Such results can be troubling and unsettling. Turbulent as it may be, only through effective evaluation can the unified arts team tell if it is reaching its goals.

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Industrial Archaeology? A New Science for Industrial Educators

Vincent J. Walencik

Industrial archaeology is a subdivision within the science of archaeology which is primarily concerned with the artifacts of industry. Most domains of archaeology lie under dust and sand built up over the centuries. As could be expected, the industrial archaeologist's domain is from the events leading to the Industrial Revolution to the present age.

The industrial archaeologist is concerned with two major studies within his discipline. The first study is pure research addressing itself to 1) written material revealing the industrialization of the site to be studied and 2) interviews with persons who recall the industrial site and incidental information concerning the sites to be investigated. The second area of study (and the more glamorous) is the actual salvage operation which includes, in many cases, the removal of many feet of top covering earth and cultural materials to reveal building structures and artifacts that may be centuries old. No unearthing of sites believed to contain historical industrial artifacts can be conducted without the research study and a subsequent site survey. This preliminary work evaluates historic resources and information for the design and planning stages of the salvage operation. The salvage work involves recovering historical data from the site. Salvage archaeology without research and survey could result in the destruction of materials not realized as having potential historic value and the wasting of monies by indiscriminate excavation in an effort to locate an industrial site centuries old.

The industrial archaeologist attempts to analyze the effects of the Industrial Revolution specifically dealing with the evolution of industries, technologies and industrial structures. What makes these studies significant is that they deal with symbols of a revolution of the human estate. The industrial archaeologist may ask: Can an understanding of the mechanics of this social process, then and now, with all its political and socio-economic implications, help us comprehend and adjust to the realities of the future?

PATERSON'S HISTORIC INDUSTRIAL DISTRICT

In 1791, a private corporation was established by Alexander Hamilton to establish an industrial city in America. This organization was entitled the Society for Establishing Usefull Manufacturers (abbreviated S.U.M.). The site chosen for this endeavor was the Great Falls of the Passaic River in northern New Jersey. The resultant effort was the creation of the City of Paterson, the first industrial city in the United States. The passing of two centuries has altered the buildings which comprised the original site as developed by the founders, and in many cases the subsequent years have covered the sites with many feet of dirt and debris.

Recognizing the historical value of the S.U.M., the City of Paterson is currently engaged in an effort to protect the Historic Industrial District (the Great Falls, including the industrial areas of the S.U.M.). During the summers of 1973 and 1974, the Historic American Engineering Record (HAER) of the National Park Service carried out an extensive survey of the architecture and history of the district. Using this information, Paterson is currently preparing an application for designation of the district as a national historic landmark. The Great Falls of Paterson is already a national natural landmark and is listed on the National Register of Historic Places.

The importance of the Historic Industrial District became apparent to the citizens of Paterson during the construction of two major highways. The Federal and State Departments of Transportation (D.O.T.'s) designed a storm sewer system, which in the original plans would have ripped indiscriminately through the heart of the district — through both the middle and lower raceways of the historic three-tiered raceway system (water power delivery system) as well as the sites of several historic locomotive industries.

In preparation for construction, the D.O.T.'s had demolished two structures within the district: a one-story warehouse, the former Grant Locomotive Company, and a 19th century erecting shop. At this point a local preservation group, Great Falls Development, Inc., solicited an archaeological reconnaissance survey of the threatened area. A significant part of the obtained survey was a statement providing for an archaeologist-observer to conduct salvage operations on the entire highway area, literally in front of the bulldozer. This contractual requirement was without precedent anywhere in the United States.

The combined efforts of concerned local citizens, state and federal government agencies have begun the difficult task of attempting to uncover and preserve the original site of American industry.

RESEARCH DISCOVERIES

At the end of the American Revolution, the new country faced the task of turning hard-won independence into the reality of becoming less dependent upon Europe for the necessities and luxuries of life. Alexander Hamilton was perhaps the most farseeing of the men who charted the course America should follow. As a Revolutionary officer, Hamilton had moved through New Jersey and visited the Great Falls of the Passaic River. Thus, it was fitting for Hamilton to play a leading role in establishing the industrial city of Paterson, which depended upon the Great Falls as its source of power.

Hamilton chose to set up a private corporation capitalized at $600,000 (an enormous expenditure just after the Revolutionary War) to accomplish his endeavor. The Society for Establishing Usefull Manufactures (S.U.M.) was to be the embodiment of this vision, demonstrating to American businessmen that American manufacturing ventures could be socially desirable and also economically profitable.

At the heart of the establishment of American manufacturing lay the problem of large-scale engineering ventures. Nothing less than a large factory would show other Americans that competition with the British could be both nationalistically and monetarily satisfying. If it was to be a large-scale development, then ample power would have to be available — i.e., the engineering development of a major river for power purposes. Americans had never faced this sort of problem before, and the project elucidated the difficulties of early industrialization in the country.[1]

After reviewing site reports as to possible locations for the hydropowered factory complex, the S.U.M. Board of Directors picked the location of the Passaic Falls as the single water power site and ordered a committee "that the town of Paterson be located upon the waters of the River Passaick at a distance of not more than six miles from the same (Great Falls)...."[2]

The S.U.M. took approximately one year to decide upon an engineering plan for the site. The plan of Pierre Charles L'Enfant was chosen from the three finalists. L'Enfant's design called for channeling a portion of the Passaic River flow above the Great Falls. This upstream entrance would be in line with the current of the river, which would consequently help to create flow through the channel. At the end of the channel, a reservoir about 100 feet wide and 10 feet deep was proposed to act as a small storage basin for evening out the flow from the river under changing demand. Exiting from the basin, L'Enfant had two main raceways (aqueducts) for carrying water to the mills. Each mill had its own headrace, overshot waterwheel, wheelhouse and tailrace. He proposed to build only one of the raceways at the moment for the S.U.M. mills, leaving the other raceways until

demand for the water increased over and above the Society's own needs. The two major raceways would have about the same head (vertical drop) as the Passaic River itself, but there could be three or four other races below this highest level, using water from the first level a second and third time on its way back to the river.[3]

During the summer of 1794, water to the first mill became a reality. The cotton mill was prepared to "set on water spinning as constant business."[4] With water power now available, the S.U.M. turned its attention to two other areas of importance. The major concern was the spinning business in the mill buildings and associated trades of weaving, bleaching and printing. The second area of concern had to do with the future of the water power development of Paterson. The Society had just spent an enormous sum of capital to bring the water to its cotton mill. Should the Society extend the raceway system to make the water power available at other locations? The decision to increase the raceway capacity made the S.U.M. the most vast power project undertaken in America up to that time.[5] After 1800, the S.U.M. became primarily a power developer and real estate firm rather than the active manufacturing corporation that Alexander Hamilton had envisioned.

SALVAGE OPERATIONS

Once research and survey studies had been conducted, salvage work to find and preserve the historical sites commenced. Work began in the summer of 1973 to draw a profile of the middle raceway as it exists today and then to excavate the area, seeking clues to its original construction and subsequent changes. Under the canal, the original retaining wall of the S.U.M. was located. Coal ash and metal residues from the locomotive shops had been spread continuously on the road beside the raceway to a depth of six feet.

The next excavations were undertaken at the Grant Locomotive Works erecting shop site (one of the historic occupants, 1871). Coal ash, cinders, and metal fragments were found in abundance. After digging to a depth of eight feet in cultural material (dirt, debris, etc., representative of a given period of time), the top of the lower raceway was located. It had been covered over in the 19th century in this area by a brownstone arched roof, transforming what had been an open raceway into a tunnel. Excavators first recognized the fact that they were standing on a tunnel roof when a hole appeared beneath them at the bottom of the test excavation and literally fell away.

Just at this time, extensive exploration work was being carried out by the Passaic Valley Water Company and the city of Paterson agencies to find a break in a water main near the Historic District. The water was known to be leaking into the lower raceway because it could be seen and smelled where the lower raceway emerged from the ground. Workers broke into the raceway and this entrance was used to explore the entire race from the inside. Excavators waded the length of the tunnel, finding four side tunnels which apparently were an outlet for a power flume coming from the middle raceway. Further exploration of this raceway revealed a beautifully constructed turn toward the middle raceway. It was surmised that this was the first flume on the hydropower channel from the middle raceway. The flume was blocked by a pile of bricks and other building debris.

Workers proceeded to excavate the lower raceway, but terminated their project when interesting remains were turning up just under the surface. When surface rubble was cleared, elements of the floor and front sill of the building just razed by the N. J. D.O.T. were revealed. This floor was identified with the Brilliant Silk Company, which had modified the Grant Locomotive Works erecting shops to serve as a textile mill.[6] Below this floor the remains of the Grant Locomotive erecting shops were located, consisting of six parallel bays, 27 feet long by 6 feet wide and three courses of brick deep. A trough in the center of each bay pitched, leading to a drain directly connected to the lower raceway which carried off the waste. The bays were the locomotive erecting sites. They carried the rails that ran into the street through a series of large doors, the distinctive street-side feature of all Paterson erecting shops still standing, such as the Rodgers erecting shop.

Between and below these bays were soon found remnants of an earlier statum of buildings — those which fronted on the open lower raceway before it was covered. These earlier buildings were part of a series of machine shop buildings associated with the New Jersey Locomotive and Machine Company which was on the site from 1851 to 1867.[7] Artifacts from the shops consisted of many fragments of metal stock and hand tools, the most common of which was the hand file.

Excavation proceeded on the site of the Rodgers Locomotive and Machine Company

(1871). This work yielded the most incredible results, for as the ash and slag were removed a maze of artifacts and features of industrial buildings and their machinery came to light. Upper strata contained almost complete footings and foundations of the circa 1873 Rodgers blacksmith shop, the 253 foot long structure running parallel to the back of the erecting shop. Below this the remains of earlier shops were uncovered. Finally unearthed were hard-to-identify remnants of some of the first buildings in the Rodgers Works. One of several features within these buildings is a forge structure dating from the mid-19th century, perhaps connected to the middle raceway by remnants of a water system in a brick arched tunnel. Also exposed were steam drop-forge or hammer bases from several periods used to fabricate metal stock into locomotive parts.

Finally, an attempt was made to locate an apparent turbine pit in the flume beside the Rosen Mill (circa 1850). The area cleared was not a turbine pit but probably part of an old waterwheel pit that had been cut in half. The northern half, not excavated, may well have been the turbine house and pit. The area in which the archaeologists worked was perhaps left open to give workers access to the lower raceway tunnel. Therefore, the archaeologists were probably entering the historic tunnel through the historic access pit.

The pit itself measured 13 feet by 10 feet and proved to be 12 feet deep. The northern side of the tunnel had a low arch of brownstone where exhaust water may have come from the turbine leading to the raceway.

Further excavation at the Rodgers site proved valuable, in that very distinctive floors and doorways were found and much equipment had been left in place. Tools found included an anvil, bits and swages from steam hammers and forges, and two complete table forges.

CONCLUSION

Programs such as the Great Falls Development Salvage Project and the Historic American Engineering Records surveys of 1973 and 1974 have materially aided public recognition of the historical importance of the area. The undertakings in the Historic Industrial District of Paterson, N.J., are unique examples of the efforts needed to preserve a city that changed American culture from a rural/agrarian to an urban/industrial society.

Note:

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International Perspective

Arts and Crafts in Australia—The State of Victoria

LeRoy Crist

We industrial arts teachers complain endlessly that the ever-changing needs of youth cannot be served due to lack of materials, equipment and facilities. For many of us it is hard to realize that people in other parts of the world have similar problems, often magnified several times by the social, cultural and/or political conditions.

In accepting an overseas educational assignment, one must realize that his expertise is limited in his own country and will be even more so when applied to the problems of another nation. Knowing this, I must admit that I went to Australia knowing that my assignment would not result in any vast improvements in the educational system of the country, that my contribution must be within the framework of their educational system, and that any deficiencies in the Australian educational system would be perceptible only because I would recognize them as deficiencies prevalent in America.

In order for Australia to progress from a country dependent primarily on an agricultural and raw resources economy to one with industrial opportunities, the Ministry of Education recognizes a need for technical training of its people and has developed various educational training sequences or paths to attempt to achieve this goal.

Industrial arts has an unusual and unique contribution to make because it is action-oriented and does involve manual work. Yet, when introduced into the Australian school system, they took on a rather curious concept which does not necessarily reflect the best practices of its origin. I think it has inherited the lecture/assignment/examination syndrome of England which is a system considered adequate for the upper classes and wealthy, but which is not necessarily relevant to a developing nation. With the rapidly changing social and cultural environment of Australia, it seems essential that their arts and crafts program be re-evaluated and revised. During my assignment in Victoria, the state's Ministry of Education was in the process of doing this very thing, which left much controversy and confusion among the educational rank and file.

STRUCTURE OF THE AUSTRALIAN SCHOOL SYSTEM

The school system structure is similar to the American system in many ways, but quite different in many others. First, the schools are arranged on the six-six plan, with grades seven through twelve being included in the Secondary High School. Much of the first four high school years is devoted to the social adjustment and general education concept. Very little attention is given to preparation for the world of work. At the completion of the fourth year (end of the sophomore year) approximately one-half of the students will leave school and enter the labor market. At this level it is possible, and common practice, for the students to enter apprenticeship programs.

The fifth and sixth years of high school are strictly college preparatory and normally do not include any industrial arts courses except possibly graphic communications. To receive a high school diploma it is necessary to pass a matriculation examination, in preparation for which the bulk of the junior and senior years are directed. Much of the ratings of the teachers, school and community are measured by the success of the students on the examination. Without successful completion of the exam, it is not possible for the student to enter the higher educational institutions.

All schools in Victoria (also in other states of Australia) are centrally controlled, with all staffing, budgeting, etc., being allotted by the State Department of Education. Supplies, equipment and other necessary items must be ordered in bulk prior to the close of the school year for the next year. Currently, an attempt is being made to de-centralize this and allow each school to purchase its own supplies, etc., from an established budget

instead of having them sent to the school from a central warehouse. If this is accomplished, it will go into effect for the 1977 school year.

ARTS AND CRAFTS CURRICULUM

With the de-centralization of the state system, one will find about as many variations of the curriculum for arts and crafts as there are schools in the state. The only courses which are somewhat atandardized are fine arts and graphic communications, with the latter being somewhat controversial, as it has just recently been introduced to replace technical drawing. Many of the technical drawing teachers still haven't accepted the State Department's concept of graphic communications. Since it is a matriculation subject, they are forced to at least teach the curriculum content so their students can pass the exam. Basically, the course is what we in America would consider commercial arts, with the inclusion of architectural and machine design.

The courses most commonly included in the arts and crafts curriculum are cookery, needlepoint, fabrics (clothing), painting and sketching (fine arts), history of art, graphic communications, woodwork, metalwork, ceramics, printmaking (graphic arts) and technical electives such as electricity, plastics, carpentry, appliance repair and home maintenance. The technical electives are only offered at the fourth and/or fifth years, and normally not more than one of them will be offered at any given school.

Graphic communications has many different approaches being advocated by the leaders in the field. Keeping this in mind, I will attempt to summarize it briefly. First, there is no consistency as to the grade level at which graphics is introduced. Some schools are introducing it at form 1 (grade 7), while others are waiting until form three (grade 9). The schools that are introducing it a form 1 normally have classes that meet once a week for a double period (40 to 50 minutes in each period) for a 14-week term. In many situations it is integrated as part of the art curriculum in the first and second forms. At the third, fourth and fifth form levels they usually allow two double periods per week, with the course either being for one-half or the entire school year.

Included in graphics is pictograms (pictographs using abstracts, symbolics and schematics), pictorial presentations, mapping, charts and graphics, monograms, pattern layouts, advertising posters and layouts and lettering. Most of the emphasis is placed on design layout, color coordination and balance, rather than line technique and accuracy. Perhaps the reason for this is that the Australian teacher is a trained art teacher with a limited amount of work in graphics and is more aesthetically, rather than technically, oriented.

In woodwork, once again, we find the art influence in the shop, as the wood teacher is an art teacher with wood being his secondary field. Much of the curriculum content is centered around design, wood sculpture and carving, as proposed by the State Department Curriculum Branch. This is a recent change from the old manual training concept, as only within the last few years has it been necessary for the industrial arts (wood) teacher to have a college degree to teach the industrial subjects in the secondary high school. Prior to this, many of the industrial arts teachers were journeyman craftsmen for the skilled trades. One interesting observation is the discontent of the parents and community with the current art-oriented courses. Much consideration is being given by the teacher education institutions to establishing a teacher training program for industrial arts teachers (graphics, woods and metals) with emphasis being placed on the technical and industrial aspect.

Many of the wood shops still contain a considerable emphasis on the manual training skills, as a large percentage of the wood teachers are still trade-trained persons who were hired prior to the requirement of a degree to teach industrial arts.

The metalwork in the Victorian schools also has an art approach, with the emphasis being placed on art metal and jewelry. Other areas generally included in the metals area are sheet metal, engine lathe work, welding and forging. Students are encouraged to produce projects of free-flowing design.

TECHNICAL HIGH SCHOOLS AND/OR COLLEGES

It would be unfair to the Australian educational system to explain the secondary high school program without mentioning the technical school program. At grade six, the student and his parents must make a choice between the secondary and technical high school.

The technical high school is also organized on a six-year plan, with the first two years being quite similar to that of the secondary high school. At the first and second form level, it is possible for a student to transfer to the other program if space is available. Normally, the technical high school fills up to the maximum capacity early, and the students who are slow in deciding are forced to enroll in the secondary high school. The technical schools have an excellent curriculum and include a broader offering of courses than most of our American Area Vocational Schools and/or Community Colleges. The students are required to take approximately one-half of their work in general studies such as math and English, but these courses are specially designed to relate to the technical fields of study that the student has chosen. Students who elect to attend and graduate from the technical schools are not eligible to enroll in higher education institutions without going back and completing the high school matriculation examination.

The State Department of Education in Victoria is currently experimenting with certain selected technical high schools by allowing the sixth formers (senior students) to apply for and take the matriculation examination. At the present time, there hasn't been enough students to take the exam to know how successful this will be, but preliminary results indicate that they are doing as well as, if not better than, the students from the regular secondary high schools. Perhaps we should take a look at the Australian technical programs for some of our curriculum considerations.

WORK EXPERIENCE PROGRAM

In an attempt to reduce the drop-out rate and develop a better understanding of the value of education a cooperative work experience program is being developed in many of the metropolitan secondary high schools. During the fourth form (sophomore year), students are placed in industrial positions for three or four weeks so they may gain first-hand experience and knowledge of the various industrial operations and requirements. This program gives the students a realistic viewpoint of the activities of industry as well as an understanding of the importance of further formal education. Many more students are now remaining in school after the legal leaving age of 15.

SUMMARY

In conclusion, I feel that my participation in the Australian school system contributed as much to my professional and education growth as I contributed to their program. I feel that participating in overseas programs has strengthened and widened my outlook so that now I can deal more effectively with problems and have a better understanding of how to deal with and work with individuals and groups. Therefore, I would encourage others to take advantage of such opportunities when they present themselves.

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A Rationale for International Technological Education

Ray Douglas Loyd

The many problems facing world societies today are often associated with technology. It is true, technology has greatly contributed to these problems, but it is seldom pointed out that the technology had been misaligned by its users. In relating design irresponsibility, Victor Papanek wrote:

> ...design has satisfied only evanescent wants and desires, while the genuine needs of man have often been neglected by the designer. The economic, psychological, spiritual, technological, and intellectual needs of a human being are usually more difficult and less profitable to satisfy than the carefully engineered and manipulated "wants" inculcated by fad and fashion (7).

This statement is equally true if "technology" is substituted for "design" at the beginning of the quote.

Technology is also defensively hailed as the panacea for world problems. Perhaps this can be true if the users of technology realize its true value is to meet genuine human needs not just temporal whims, fancies, wants and desires.

If the societies using technology are over-zealous in satisfying their desires, technology can and does take on a destructive nature. Nelson aptly stated:

> Technology is a constallation of interlocking systems and activities that get work done with a constantly diminishing input of human labor. Technology began as an extension of tools and as such brought uncounted blessings with it. Now swollen beyond any conceivable human scale, it rolls along, a blind Moloch overriding all needs of the human spirit, all traditions, customs, languages, races, ideologies (6).

Technology is of an international scale and should be expressive of the needs of all the people from all nations. Or of the biggest problems with technology is the way some nations claim sole proprietorship of "their" technology and express an unwillingness to share. If anything is vitally important to the survival of humankind, it is a united effort to use and control technology effectively. We must work together for the betterment of but one kind, humankind. Deutsch exemplified the pressing need for such an international effort by writing:

> Attention must be given to the truly terrifying problems facing humanity; population explosion, mutual atomic over-kill, contamination of water and atmosphere, the dangers of exclusive self-authenticating orthodoxies and the tendency to dispose of groups of people and nations through superficial stereotypes (1).

It may appear beyond our present conception of world cooperation but in a quote by Henderson, Victor Hugo envisioned, "...first the United States of Europe and then the United States of the World." (2) It is currently unthinkable and surely unfeasible for this to happen. The world populace today is divided politically, economically, racially, ethnically, socially, religiously and physically. Nationalism though, "claims that primary loyalty of man today. In so doing, nationalism serves as the greatest divider of humankind." (5) Technology should transcend all these assumed deterrents with universal goals directed toward the betterment of all humankind.

Are the people in a nation of wealth based upon technology so protective of their goods that they are blind to certain facts? They rape the environment for the good of their country or they attempt to manipulate people from underdeveloped nations. Deutsch shared his perception of the elusive reason by writing:

> ...the meaning of the twentieth century is manifest in the rapidity of change, the linkage between the have and have-not nations and people, the dilemmas of population, growth, and the capabilities of worldly destruction. (1)

It should be apparent that all people on earth utilize their resources through technology. Sharing in the spoils and suffering the consequences of this endeavor should be the goal and responsibility of all nations. This would require a complete break in traditional barriers. It would also require a technological exchange between all nations.

An international cooperative system of education would facilitate this technological exchange. The potential for cooperation and reciprocity exists with all countries. It is not a one-sided affair for no single system has ever been able to satisfy fully the educational needs of each individual. It also transcends the belief that the participants are the sole beneficiaries of international education exchange programs. The late President Lyndon B. Johnson was quoted by Speakman as stating:

> International education cannot be the work of one country. It is the responsibility and promise of all nations. It calls for free exchange and full collaboration. We expect to receive as much as we give, to learn as well as to teach. (8)

Technological education is far more reaching than the individual, its implications encompass all living things and thus must be a global affair.

The world's nations must strive for international, intersocietal and intercultural cooperation and understanding. A very important concept to be stressed is that we inhabit but one planet and it is the earth. It belongs to all the inhabitants and they must work together to protect and preserve their habitat. Ideologies, philosophie and politics develop only because there is a physical entity inherent in human existence. Until we reach the ultimate of spiritual existence we must work together regardless of race, religion, creed, nationality, ethnic background or any of the other pseudo differences between people. The critical message is that we are of but one race, the human race.

The hopes of all nations are based upon technology. Society is dependent upon technology to provide new and better life styles. Primitive societies separated from modern technology until recently suddenly switched from stone to metal tools. This was a major step toward becoming a technologically dependent society. They now expect more technology to be given to them so they can become "civilized."

Nations that are making every effort to become industrialized and technologically oriented reject the term of "underdeveloped nation" for the term more descriptive of their goal of rapid development, "developing nation." Unfortunately, the primitive tribes and the developing nations are disregarding human needs because of a misinterpretation of technology. To correct mistakes and prevent further error, all nations should work toward an international technological education.

In a discussion of the interrelated world problems, Lamy, Newkirk and Miller cited world conferences as exemplifications of global concern and "the necessity for international cooperation to create meaningful solutions in these areas of concern." (4) Global interdependence does demand international technological education interchange and a concerted effort should be made to expand and promote this interchange. Technology can serve as a benefactor and unifier of humankind, but Hungerford has warned:

> ...technology is not omnipotent, nor does it have intellectual capacity. Ultimately, man must make the decisions concerning technological impact on the environment. (3)

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Global Interdependence Demands Technological Interchange (Industrial Technology)

William D. Wolansky

This paper focuses upon the assistance projects designed to help underdeveloped countries expand and strengthen their systems of industrial education. Upon the basis

of several studies and personal experience gained in planning and executing such assistance programs, I will outline brief guidelines for those who may be involved in the future in such an assignment and briefly outline the role of a consultant in developing country assignments.

BACKGROUND

Global interdependence did not emerge with the inaugural flight of the SST Concorde to New York. Some 20 years ago the collective thought captured by a United Nations report laid the foundation for global interdependence, awareness and interchange of industrial technology. The supporting statements follow:

> To an extent which might have seemed inconceivable even 50 years ago, as a United Nations study on world social conditions points out, there has come increasing recognition that 2,400 billion people have somehow to contrive to live together, and share together the resources of the earth; that general impoverishment of any area is a matter of concern to all areas; and that the technical experience and knowledge acquired in rapidly changing industrialized societies have somehow to be made available to those communities that are less advanced and less equipped....
>
> That this has come to pass is historic and inspiring fact. Indeed, it has been suggested the Twentieth Century will be chiefly remembered in future centuries not as an age of political conflicts or technical inventions, but as an age in which human society, dared to think of the welfare of the whole human race as a practical objective.[1]

Couple with these statements that it took 80 years to move from 1 billion population to 2 billion, and then we doubled the population from 2 billion to 4 billion in the last 40 years, and it is anticipated that we will again double the world population by the turn of this century. It becomes abundantly clear that such a population will need greater availability and access to resources, energy and alternative forms of education. As Harbison pointed out, unless we develop the human resources, we cannot expect to improve our lot socially, politically, economically or spiritually.

For more than 40 years, as part of the overall American assistance to the underdeveloped areas of the world, the United States has been engaged in projects designed to help underdeveloped countries expand and strengthen their systems of industrial education. To date, assistance projects funded by numerous agencies, foundations, corporations and associations have been undertaken in more than 40 underdeveloped nations. Sidney C. High, very insightfully stated his observation:

> Industrial education has come to be widely recognized as an essential component of national plans for industrialization and economic development, and as the United States continues in its efforts to help in the economic growth of the underdeveloped areas of the world, assistance projects in industrial education will conrinue to form an important part of these efforts.[2]

In the operation of assistance projects in industrial education during the past 40 years, much valuable experience has been gained and several books have been published which should be valuable to persons engaged in programs within underdeveloped countries. If future assistance efforts are to be improved and to be made more effective — and those of us who have been involved know they can be — it is important that the previous experience be systematically studied, organized and applied to the planning and carrying out of future programs.

Frequently governments and funding agencies are mutually motivated by social and economic development in funding industrial education programs in developing countries. The partnership and dialogue with those responsible for planning frequently precede the appointment of a project director or staff and program consultants.

A study conducted by the United Nations Research Institute for Social Development on Vocational Training in Developing Countries: A Survey of Expert Experiences drew this observation:

> Studies conducted in a variety of settings...have highlighted the importance of qualitative deficiencies in human resources — specifically, shortages of trained personnel and various

skills — as a limiting factor on the capacity of developing countries to absorb new investment. Knowledge, skills, capacities and attitudes of people are now considered to be as important for development the provision of capital — if not more so.[3]

Because of these deficiencies, we in industrial education are fortunate to have the opportunity for involvement. However research would cast caution to us. Perhaps one caution is that we who become involved need to possess not only the skills of our particular profession but we need to recognize that cultural differences, bilateral agreements, administrative structure and stage of technological development will present a unique set of circumstances and problems.

How does one even begin to contemplate a set of guidelines that would function even minimally in such diverse cultural settings? The performance requirements of a project director, supervisor, teacher and consultant further complicate the problem of what would constitute workable guidelines.

In spite of the complexity and diversity which impinge upon the problem of establishing such guidelines, I have drafted several guidelines for your consideration and discussion. I do this believing that some beginning is better than waiting for someone to take courage and perhaps failing to get the ball rollin... These guidelines are:

1. Comprehensive planning (master plan) is necessary to establish long-range and short-range goals, objectives, priorities and procedures. The host country or agency, assisting body and consultants need to know the objectives of the program if the vast range of activities provided by all parties are to be integrated into a developmental plan. Frequently such plans are prepared by the host country with expertise assistance provided by the funding agency. Project feasibility studies provide the data base for subsequent planning.
2. An industrial education project in an underdeveloped country should acquire bilateral agreement between the host country and the assisting body or contracting agency. Funding agencies, foundations and assisting bodies may engage in negotiated contracts without clearly defined policies and procedures. For example, as a consultant are you an employee of the funding agency or the institution you provide the services to during your work period?
3. Large scale, long term plans must be endorsed by national leaders of the recipient country and executive officers of the funding agency. Governmental agencies, international organizations and foundations frequently find such endorsements to be mutually beneficial and necessary. Long term projects tend to be more action and experiment oriented and bring the key administrators of the funding agency into a working partnership or dialogue with those in the host country responsible for making and executing public policy. This is particularly true of vocational education or industrial education.
4. Sufficient assistance in relation to any proposed expansion — physical facilities, equipment, skilled personnel, consultants, evaluation, management, instructional materials — is generally limited to underdeveloped areas rather than underdeveloped countries. Two viewpoints are followed in assisting developing countries. One view supports an emergency short-term impact with funding to absorptive capacity; the second and more logical is the long range planning carried out in a sustained manner for several years. Problems arise here. As government agencies change so do appropriations; economics also change. Military skirmishes, civil wars, etc. also interfere with progress of long term projects. Whatever funds are available, the problem is generally not with a lack of funds but rather with acquiring the resources and local commitment to expedite program development and expansion.
5. Provision for an advisory board on industrial education is necessary from several points of view. Local input into the planning is vital to establishing a nucleus of leaders possessing community understanding and acceptance of the project. Local educators must learn how to utilize the community resources through the use of the advisory board.
6. Consultants should be used to provide specialized services needed. A vast range of activities cound be provided from conducting a feasibility study to evaluating a project. Most consultants work on temporary or contractual terms. They are generally backed by university research capabilities and resources.
7. Specialists frequently are employed to provide necessary assistance in program planning, execution and staff development. The tendency is to retain the professional specialist on a limited contract, sufficient in duration to enable local personnel in the host country to understudy these experts and take over the administrative and instructional roles.
8. Because graduate programs are not readily available, graduate fellowships and staff development must be an integral part of any large scale assistance project. This too is a long term

subproject. Costs for travel, campus housing, out-of-state fees, research and graduate program enrichment are unusually high.

9. Personnel stability is a desirable factor for continuity in the policies and operation procedures of a given project. Where specialists are retracted and indigent staff take over the major responsibility for the operational program, it is essential that the organizati and procedural components have been sufficiently understudied.
10. An evaluation project or program evaluation must include a scanning of all components beginning with prepared plans, staff, curriculum, instructional equipment and materials, facilities, costs, etc. in terms of project goals and objectives. In-depth study of obvious difficult areas should lead to necessary adjustments. Periodic evaluation findings should be shared with administrators, the funding agency and project staff.

Those seeking guidelines for assistance programs will invariably find themselves in a new culture with differing values, priorities and attitude toward industrial education. Ultimately it will become necessary to find responsible, active and aggressive local institutional and community leaders to support the expansion of a particular program. The students will be the best advocates of your program.

THE ROLE OF THE CONSULTANT

The consultant is looked upon as an outsider. As a newcomer to the project or program, he can readily see the problems, the inefficiencies, the wastes and the organizational limitations to which local personnel have become inured.

A consultant is trained to ask questions and to focus his attention on trouble spots. One might say that his principal role is the task of analyzing alternatives and preparing recommendations.

Consultants are employed to provide contractual or advisory services. They may provide a wide range of activities but are frequently contracted to provide very specific services.

Consultants emerge from many agencies. There are individual consultants with particular expertise, those working out of large consulting firms and others working out of research institutes, government agencies, international organizations (International Labor Organization, International Bank of Reconstruction and Development and International Cooperation Agency) and the universities.

In each case the independent judgment and experience of a respected outsider may provide fresh skills, find a fresh approach to a problem, apply previous methods used in the developed country, concentrate on fundamental problems and prepare future plans with minimum distractions.

Roles of the consultant are:

1. The consultant should have the client organization identify and clearly define the problem before he decides to accept or reject a specific consulting assignment: What needs to be done, when, what funds are available?
2. He should study the contract, its essential points, the client-consultant relationship, fees, reports, deadlines.
3. He should know the specific tasks to be performed, the available internal resources and other previous local consultant reports.
4. He should know the persons he will be reporting to and presenting the recommendations to. He should learn some of the biases and previous barriers that could not be overcome.
5. He should do his research diligently collecting all available data related to the specific problem area and interview persons who have concern and information about the problem.
6. He should work in his area of expertise and analyze alternatives and call on other specialists if necessary. In preparing recommendations it may be wise for him to propose various cost models. It is important that the recommendations are implemented if his services are to be continued.
7. He should justify his recommendations with accumulated data. Projections must be determined with care.
8. He should review the tentqtive report and be prepared to revise it after discussion with the administrators. All insights and information which confirm or strengthen the recommendations will improve the final report. He should include an administrative abstract for clarity and brevity of report.

9. He should check to ensure that all duties and services were provided as specified in the contract. The findings should answer the various components of the problem.
10. He should prepare a bill and fee voucher for his services.

I have found a publication which will be particularly helpful to persons who wish to become a consultant in a developing country. It is Manual on the Use of Consultants in Developing Countries, United Nations Industrial Development Organization, Vienna, U.N., New York, 1972.

As a professional, expertise, ethics, dedication and sensitivity to cultural differences make the important difference in success and reward or failure and disappointment. In either case, the consultant is richer because of consulting experience.

In summary there are three components which are essential for international technological exchange. These are a human basis for involvement in such projects, a manageable set of operational guidelines for all those involved and clearly defined roles of all personnel directing and responsible for the project mission objectives.

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Metrics

Total Immersion in Metrics

James M. Caldwell

To make this presentation applicable to your shop or laboratory, you will have to think METRIC. If you do this, your program will be successful. The metric system is the application of the decimal number to weights and measures.

I probably would not be presenting this today if William the Conqueror had not arrived in England in 1066. Prior to this time, England had a multiple-of-ten system in mathematics. If your Congress had enforced its original Weights and Measures Act, both England and the United States would have adopted the metric system years ago.

The metric system has no fractions or "imperial" terms (referred to as "customary units" in the United States), only decimal and metric terms. This system of measurement has developed in five stages: (1) Napoleonic - meter, gram, second; (2) C.G.S. - centimeter, gram, second; (3) M.K.S. - meter, kilogram, second; (4) M.K.S.A. - meter, kilogram, second, ampere; and (5) S.I. - (Systems International) - with its seven-base units - meter, kilogram, second, ampere, Kelvin, mole, candela.

These developments were influenced by the following historical events:

1. In 1790, the French National Assembly Committee began work on the possibility of a rational system of measurements.
2. In 1870, Britain and the United States authorized the use of metric weights and measures. At the same time, France called an international convention to unify and standardize the varying metric systems that were then being developed. This conference ended with the signing of a treaty on metrics and the formation of the International Committee on Weights and Measures.
3. After World War I the M.K.S. system was introduced and became a working tool of the electrical industry.
4. After the World War II the International Electro-Technical Commission developed the Giorgi System or M.K.S.A.
5. In 1967-68 the International Commission on Weights and Measures adopted Systems International.

The metric system that I will be talking about is the latter, Systems International, not the Continental metric system which you may have had in your schooling and which is still in use in most mathematic textbooks today.

There are four basic reasons why the world is going SI metric. They are: (1) Uniqueness - each quantity has only one unit, (2) simplicity - a decimal structure, (3) coherence - having no conversion factor, and (4) absoluteness - independence from gravity.

This system was recommended to the world's governments in 1968 by the International Committee for Weights and Measures. It was endorsed by two other international committees: One on standardization and one concerned with electro-technical matters.

There is only one standard for each unit. This is set by the International Standard Organization which is composed of 70 member countries, representing about 90 percent of the world's population. In the imperial or customary system, units of measurement and capacity vary among countries: for example, a difference of 240 pounds may exist between the long and short ton. The fluid units of measurement also vary between England and the United States. Even though the terminology is the same, our gallon is one-fifth larger.

In the first 100 years of its use, 1780-1880, about 20 percent of the world adopted this measuring system. In the next 50 years, 1880-1930, its use had spread to about 60 percent. In the last 50 years about 90 percent of the world have committed themselves to metric.

The reasons that we in Canada have gone metric are:

1. Its use of the decimal system.
2. It is used by 90 percent of the world's population.
3. Units of measurements are precisely the same in all countries.
4. All units of measurement are rationally related to one another.
5. About 80 percent of the world's trade and commerce is conducted using metric units.
6. The world has become a "global village" and we in Canada cannot isolate ourselves from this world.
7. It is in harmony with our accounting and monetary system.
8. All standards are international.
9. Our industry is converting for economic reasons.
   (a) Reduction in the multitude of available sizes.
   (b) Reduction of inventory.
   (c) Simplified accounting.
   (d) Conformity to the law of the land.

Labor unions are cooperating in the implementation of this program.

In Canada, metric conversion is being introduced and controlled by the Metric Commission in Ottawa, with the aid of four federal departments and their counterparts at the provincial level. The development of standards and the educational program in industry and education is governed by 11 sectors or steering committees. Committees are composed of representatives from over 200 national organizations, from industry, agriculture, education and consumer groups.

The metric conversion program is being introduced in Canada in three stages: (1) Awareness, 1970-1974; (2) preparation, 1973-1976; and (3) implementation, 1975-1980.

The transition period is between 8 and 12 years, with 1980 as the target date. If the United States government decides to go metric, our country will reduce this period to eight years in order to increase the effectiveness of our industry in international trade.

In S.I. there are only seven base units. The rest are derived from these units.

BASE UNITS OF S.I.		
1. Length	meter	m
2. Mass	kilogram	kg
3. Time	second	s
4. Electric current	ampere	A
5. Thermodynamic temperature	Kelvin	K
6. Amount of substance	mole	mol
7. Luminous intensity	candela	cd
SUPPLEMENTARY UNITS		
1. Plane angle	radian	rad
2. Solid angle	steradian	sr

The standard for the meter was set 200 years ago. It was one-quarter millionth of the earth's circumference through the Poles on a line through Paris, France. Today's measuring methods have proven this inaccurate by a few meters. Since 1960 one of the wave lengths in the red-orange range of the element krypton 86 has been used as the base for the meter. The use of light refraction in measurement provides extreme accuracy.

In the S . metric system, no abbreviations are used. The way that the units are pronounced or written may vary between languages, but the symbols are the same in all languages. The symbols are not identified by punctuation and are used only in the singular form. They may be used directly in any algebraic problem.

The quantity or amount of any unit is indicated by a prefix from TERA (10^{12}, one trillion) to PICO (10^{-12}, one trillionth). Such terms as TERA, GIGA and MEGA are at present being used in our province to describe present and future hydro power requirements. With the use of S.I. units and prefixes, personnel in the fields of chemistry and the electrical, atomic, space and earth sciences will be able to talk to each other without conversion charts for the first time. This is because all base and derived units are connected, whether they represent length, mass, time, energy or temperature — whether they are positive or negative.

The S.I. metric system is governed by 18 basic rules. If we follow these rules, the introduction of metrics into the public schools will be easy and successful. These rules are simple and logical. If the multiplicity of names and the fear of learning a whole new vocabulary seem alarming, be at ease. The government of South Africa says that the understanding of only 12 words is the basic requirement for the average person to use this system.

These words are:

mega	kilo	deci
centi	milli	meter
hectare	liter	gram
metric ton	pascal	degree Celsius

The units of electricity and time are not affected by metrication.

Imperial and customary volume each have 11 standard units. These units are replaced by only two in metric. They are: (1) The cubic meter or metric tonne, and (2) the cubic decimeter which in the continental system is referred to as the liter.

In the units of force, four terms will replace the seven presently used. In units of linear measurement from the light year to the micrometer, there are only five terms in S.I. metric. In the imperial or customary system, from the reduced distance of a nautical mile to a mil, there are 12 terms.

In Canada, we have already converted weather reporting to metric terms with Celsius temperature, millimeters of rain and centimeters of snow. Health and beauty products are now packaged in metric units. Dairy products and soft drinks are being converted. The wine industry, which had 56 sizes of bottles, import and domestic, will reduce the number to five sizes.

So far we have discussed the general background of metrics in Canada and the world. Now the development of S.I. metrics will be described in the Industrial Arts Department of our school.

In spring 1971, the members of the industrial arts staff in our school were discussing the metric system. The Canadian government had presented a White Paper to Parliament in 1970 on the advantages to our country of converting to the metric system.

During the fall term we discussed the feasibility of introducing a pilot program of metric education in industrial arts. We received permission from our board and the Department of Education to begin this program. When permission was given, neither we nor the granting authorities had heard of S.I. metrics. More by luck than good guidance, we became aware that S.I. did exist.

It had always been our practice to buy steel scales manufactured in England because they are easier for the students to read and more economical. When we received the new metric scales, they were marked zero to three hundred millimeters with no centimeter markings. This was a surprise so we contacted the representative of one of the manufacturers of steel rules located in our city and asked for an explanation. We were informed that the continental metric system was on the way out, and that all metric countries were changing to the S.I. system. He was not fully conversant in this system but did contact his home office for additional information that they might have had on this new metric system. British Steel forwarded to us pamphlets and photo copies of articles that had appeared in publications and newspapers and the name of London's school librarian, whom we contacted. The school librarian provided us with curriculum outlines and two basic reference books. One of these texts was used as the guide in developing the industrial arts metric program in our school.

The delay in receiving the minimum tools required to begin the program caused each shop to begin the project at a different time. The delay was caused by the lag in tool manufacturing proportional to the demand caused by metric conversion in England. The drafting shop had no problem in acquiring metric architect and engineering scales because one of the large suppliers in our area, a German manufacturer, was already manufacturing metric equipment. The auto shop had no problems in acquiring metric wrenches and sockets bevause one-fifth of the cars on our roads are metric imports. By fall 1972 we had acquired enough equipment to start the program in drafting, auto mechanics and woodworking. The metal shop conversion was delayed until spring 1973.

In drafting, three ninth grade classes of similar ability were selected to participate in the project. One class was completely immersed in metrics; the second used a conversion program; the third remained on the imperial system to provide a base for evaluation of the metric program. In the all metric class, a detailed background of metrics was presented. In the conversion class, the emphasis was on the conversion of imperial to metric units.

In a scales-reading test, after the third cycle (a cycle equals 2-1/2 hours) the class that was immersed in metric was approximately 20 percent superior to the class in the imperial system, while this class was 5 to 10 percent better than the conversion class. A survey taken at the end of the eighth cycle showed that 80 percent of the metric class could read and understand the metric scale. The conversion class was having more difficulty than the metric class; only 55 percent stated that it was easier to read the metric scale.

In centering a drawing which involves subtractions and additions fewer mathematical errors were made using millimeters than for the same operations using the imperial fraction system.

In the woodworking shop, one class in seventh grade and one in ninth grade were selected to participate. Here the program used was conversion. The practical work in this shop required using only linear and volume S.I. metric units. From the results of six different practical tests in linear measurements the seventh grade students, when using the S.I. metric system, were more successful in accurately measuring to the nearest millimeter than students of the same ability using the imperial fraction scale to the nearest 1/16 or 1/32 inch.

The grade nine students immersed in the meter system were more competent in the English imperial linear measurements and therefore tended to use it in both thinking and working. However, as they worked and used the S.I. metric system they were surprised at how easy it was to use. In fact, a year later these same students, now in first year of high school, requested that they be allowed to convert the dimensions of their projects

from imperial to metric. They found it more efficient in preparing their bill of material, figuring the cost of their project and accurately laying out their projects.

In teaching volume measurement (d m^3) which takes the place of figuring board feet, the seventh grade students had difficulty using the power of 10 in multiplying and dividing. This difficulty was compounded because they did not know their times table. This was not a problem in grade nine. Here, mathematical accuracy became a problem.

In the auto shop, three ninth grade classes were selected to participate and S.I. metrics was introduced as part of a general auto course. The emphasis was on metric size, thread and displacement. Metrics were introduced into practical problems such as measuring and checking manufacturer's tolerance. Metric tools were in continuous use by these classes as they dismantled and assembled motors manufactured to metric standards.

Immersion directly into the metric system with no conversion is recommended by the British Consultative Committee on Metric Curriculum. This approach was reinforced by our experience in this pilot year. We discovered it was easier for the students to use metric measurements without conversion, especially those students who might have been classed as slow learners.

In fall 1973, all four shops placed the complete junior high school program in total immersion of S.I. metric with no conversion, except in the auto shop where a dual program was introduced in the servicing of power plants manufactured in both metric and the imperial measuring systems.

In 1974 our high school program in industrial arts was converted to metric. Here, because of the limited amount of information and drawings available in metric, conversion had to be used to allow a wide range of project selection by students.

Today our program is totally metric. We are the only department in our school using the metric program. In the last two school terms we have changed our means of introducing students to metrics completely. As I mentioned previously, we began with a detailed introduction, including rules and procedure for S.I. metric. Experience has shown us that this is a waste of teaching time. Now we start each term as if the student is already living in a metric world and using it everyday. This has resulted in complete student acceptance.

In developing this program, the major problem that we encountered was the lack of backup services which every teacher depends upon. Textbooks, for example, were a major problem, as no suitable ones were available. The British textbooks, which are very limited, are written on the assumption that the reader knows S.I. metric and the related trade practice standards. The rest of the available textbooks use the conversion approach which has many pitfalls. The most prominent of these limitations is the use of decimals. One of the laws governing S.I. metrics is simplicity of application. Therefore the multiplicity of decimals is inconsistent with this rule.

Also, there were no films or film strips, transparencies or teaching aids available when we started, and these are still unavailable. The same thing applies to working standards and allowances, the new standard sizes of material and the approved trade standards. We had to develop these for our own classroom practices. I am happy to report that a large percentage of these have been adopted as the national standards by their particular sector committees.

As we used the total immersion system, all work had to be prepared by the teacher to eliminate student conversion. In drafting, for example, this required a multitude of drawings to cover our 6-year program. In addition to this, print-reading tests, symbol-reading tests, transparencies for each theory and practical lesson, and the midterm had to be prepared. In the other shops work load and preparation were as heavy.

Approximately 2 years ago, when our publishing industry entered the field of publishing metric textbooks, the continental system which was familiar to them was used and the drawings themselves were merely converted to metric numbers. These we rejected in our book reports. Now, our publishing industry is ready to publish textbooks using the S.I. metric system. Their sales managers have asked us to review draft texts for content and reliability.

In conclusion, I briefly mention the cost of our experimental program. Conversion costs were not as expensive as we had anticipated. They were approximately 2,000 dollars: 400 dollars in drafting, 250 dollars in woodworking, 700 dollars in metals, 450 dollars in auto mechanics and 200 dollars in electricity.

These cost figures are being used as a guide by our Provincial Government and the

Federal Educational Sector in projecting the costs of educational conversion to S.I. metrics.

When you in the United States enter the metric world, we would recommend:

1. That the new maths are revised to emphasize the numerical systems that can be readily transferred to metric.
2. That you introduce metric to your program as complete immersion.
3. That the introduction to your program is simple.
4. That textbooks are evaluated carefully. Our experience shows that 70 percent of the texts we received contained fundamental errors. The same would apply to equipment which emphasizes the decimeter, centimerer, decameter and hectometer.

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The SI Metric System in Power and Energy

Anthony E. Schwaller

The objective of this special interest session is to enable you to communicate measurement of power effectively in the Systems International (S.I.) metric system. To accomplish this objective, each of you should be able to:

1. Identify the seven basic S.I. metric system units.
2. State and use the common prefixes used in the S.I. metric system.
3. Identify the interrelationship between length, volume and weight in the S.I. metric system.
4. Spell, pronounce and write S.I. metric terms correctly.
5. Recognize common S.I. special units.
6. Work common problems in the S.I. metric system.
7. Compare the soft and hard conversions.
8. Identify all metric units used in the area of power and energy.

ADVANTAGES OF USING THE S.I. METRIC SYSTEM IN POWER AND ENERGY

In the field of energy and power, and especially in the field of automotive technology, the metric system is going to have an impact. Let us take a look at some of the advantages and disadvantages of using the metric system in this field.

To begin, the S.I. metric system is an international system of measurement. Only seven units are used in the metric system, while many more are used in the English system. All units are based on powers of 10 rather than a base of 12 as for inches or of 16 as for ounces. All units in the metric system can be laboratory-simulated. Many of the units used in the metric system are already being used in the United States.

Along with these advantages, the automobile manufacturers and many other companies have already started a conversion program within their company. We as consumers are going to be exposed more and more every day to the metric system, especially in the field of automotive and power technology. For example, Chrysler Corporation measures all of their engine sizes in liters. The Gremlin has "3.2 liter engine" printed on the back of the automobile. Many foreign cars which are now being shipped to the United States are also using metric sizes and measurements for determining the size of engines. Many roadway signs are already being converted to the metric system. Rather than using miles per hour, kilometers per hour are used.

BASE UNITS

To understand the metric system, we must first understand the seven basic units of measurement used in the S.I. metric system. The first is called length. The S.I. metric

name that is used to describe length is the meter. The symbol used is "m." What is a meter? It is 1,650,763.73 wave lengths of krypton 86. A door is approximately 2 meters high. A swimming pool is 25 meters long.

The second unit used is mass. The metric name for mass is gram, and the symbol used is "g." Anything that has mass or weight can be measured by grams. We have all heard the term "kilogram." This is also part of the base unit gram. A gram is a very small unit—possibly too small to apply to many of the common mass measurements.

A third unit is time. The metric name for time is second, and the symbol is "s." Let us analyze what base unit or what power is being used when we talk about a second and a minute. The power of 60 is being used; 60 seconds equals 1 minute, and 60 minutes equals 1 hour. This is the only metric unit that is not based on the power of ten.

The S.I. name for electric current is ampere, and the symbol is "A." This unit is used in the United States today. Many other terms are derived from this unit, such as the volt, coulomb and watt.

The fifth unit, temperature, has the S.I. names of Kelvin and Celsius. The Kelvin scale uses the symbol "K" and the Celsius scale uses the symbol "C." In engineering circles, the Kelvin scale predominates. When dealing with power and automotive technology, the Kelvin scale is not used. Since the Celsius scale is used more often, we will discuss this scale.

Let us compare the Celsius scale and the Fahrenheit scale. We all are familiar with the range of the Fahrenheit scale; water boils at 212°F. and freezes at 32°F. On the Celsius scale, water freezes at 0°C and boils at 100°C. There are 100 units between freezing and boiling water. Body temperature equals 25°C. A warm day would be 37°C. The Celsius scale can be broken down by the power of 10. This is also referred to as the centigrade scale, but centigrade scale is not the proper terminology. Centigrade comes from the word "centi" meaning 100.

Illuminous substance is measured by the S.I. metric name "Candella." Its symbol is "cd." The amount of substance is measured by the S.I. name Mole and its symbol is "mol." Because these two base units are used in engineering circles, it would not pay for us, as consumers in automotive technology, to delve into this area. In automotive and power technology the three most important units are meter, gram and Celsius.

PREFIXES

To understand these units, prefixes must be considered. Referring to one of the advantages discussed earlier, all units are based on powers of 10. To measure something larger than a meter, we multiply the meter by 10 and attach a prefix to the base unit. For example, a decimeter equals 10 meters. Let us call the base unit 1 times 10 to the 0 power. Now, let us use the meter as the base measurement. If a room is 22 meters, this is equivalent to 2.2 dekameters. The symbol is "da" for deka and "m" for meter. This concept can also be applied to mass. The symbol "g" for gram would be used with the symbol "da" for deka indicating dekagram. This equals 10 grams. A dekameter or 10 meters multiplied by 10 again is 100 meters. This can be referred to as a hectometer and the abbreviation is "hm." A hectometer is 100 meters or 10 dekameters. Multiply the meter by 1,000. This length is referred to as a kilometer. "Kilo" stands for 1,000 or 10×10^3. The symbol is "k" for kilo and "m" for meter. If we were using grams, it would be "k" for kilo and "g" for gram. One thousand grams has the same mass as 1 kilogram. Kilogram and kilometer are two common terms in the S.I. metric system.

Other prefixes indicate greater quantities. For example, "mega" is 10 multiplied by 1 million, or 10×10^6. The symbol is "M." A megameter is 1 million meters in length. Other prefixes are used such as "giga" and "tera." These two are not commonly used in our particular area, but they may be used a great deal more in the future when talking about large distances in space.

What prefixes are used if we are to talk about minute measurements—expecially in the field of machining automobile parts? Let us start with the base unit, meter, again. If the meter is broken into 10 equal parts, each part is a decimeter. The symbol for deci is "d." A decimeter is about as long as a toothbrush. The symbol for decimeter is "dm." A gram subdivided into 10 equal parts is called a decigram. Although this is done, it is too minute for many measurements. Going one step further, break the meter into 100 equal parts, which is the same as breaking a decimeter into 10 equal parts. "Centi" is the prefix, and the symbol is "c." The symbol for centimeter is "cm."

A centimeter is approximately the width of a paper clip. One hundred cm equals 1 meter. Ten cm equals 1 decimeter. If we break the meter into 1,000 equal parts, this distance is approximately the width of a pencil lead and is called a millimeter. "Milli" is the prefix. The symbol is "mm." Millimeters are used frequently to size wrenches and other tools used in the automotive field. For example, there are 11-millimeter wrenches, 13-millimeter wrenches and 15 mm wrenches, etc.

Subdividing a meter into 1 millionth of a part produces a micrometer, 10×10^{-6}. A nanometer is 10×10^{-9}; a picometer is 10×10^{-12}. These are used in scientific and engineering circles. For our purposes we should be concerned only with the decimeter, centimeter, millimeter and micrometer.

INTERRELATIONSHIP BETWEEN LENGTH, MASS AND VOLUME

One of your objectives dealt with identifying the relationship between length, volume and mass. To help clarify this task, we will describe this interrelationship using the gram and the meter. If we take a centimeter and put ten of them together, the combination is called a decimeter. If we put ten more cm perpendicular to them, the total area will be 100 centimeters squared. This is the same as one decimeter squared. The concept of squaring in the English system can be also applied with the metric system units. There is absolutely no difference. Centimeters squared, meters squared, or millimeters squared is always written (cm^2). For example, 100 centimeters squared is written 100 cm^2. If an area contains 10 cm in length and 10 cm in height, there is a total of 100 cm in area.

Let's add a third dimension to this concept. Using 100 cm^2, add a depth of 10 cm. The result is cubic measurements. Again, this concept is no different than current use in the English system. How many cm^3 would be in the above problem? There would be 1,000 cm^3, which is the same thing as one cubic decimeter. Using this as a volume measurement, one can see the applied uses in the automotive field. The size of an engine can be measured in cubic centimeters or cm^3.

Many outboard engines and cycle engines have already converted to this system; cm^3 is often referred to as cc. Using this concept, 1,000 cubic decimeters would be in one cubic meter. If a cubic decimeter were filled with water at $4^{\circ}F$, one liter of liquid volume is the result. One liter is also one kilogram of mass. This is the relationship between length, width, and volume; together they make up mass. Based on this concept, the mass of a cm^3 is equal to one gram. This is one of the distinct advantages of using the metric system. All of the units combine and work together.

SPECIAL UNITS IN POWER AND ENERGY

One of the special S.I. metric units used in the field of energy and power is frequency, now measured in "hertz." This has been in use for several years. A new term to many might be force. Force in the S.I. metric system is referred to as "newtons." Its symbol is a large "N." Force has always been measured as mass times acceleration. In the metric system, this means the mass will be in kilograms and the acceleration will be meters per second squared. Therefore one newton, applied to a mass of one kilogram, gives an acceleration of one meter per second squared.

Another expression that is used quite extensively in the field of power and energy is work or energy. By definition, work or energy has always been force times distance. Force, which is now measured in newtons, times distance, which is measured in meters, will now be termed joule. Its symbol is "J." A force of one newton applied through a distance of one meter produces one joule of work. Power is simply the rate of doing work, which in the English system has always been defined as horsepower. If work is defined in terms of a joule, then dividing joules by seconds would give the rate of doing work. One joule of work done in one second is equal to one watt of power.

Another term used often in the field of power and energy is pressure. It is defined as the unit of force applied to a unit area. A unit area in the metric system has been defined previously as a $meter^2$. Force in the S.I. metric system has previously been defined as newtons. If we apply a newton to one square meter, the result is defined as a pascal. The abbreviation in the S.I. metric system is "Pa." These four derived units, force measured in newtons, work measured in joules, power measured in watts and pressure measured in pascals may be applied directly to energy and power systems. For

example, torque wrenches will now be measured in newton meters. Brake mean effective pressure (BMEP) will now be measured in pascals. Horsepower will be measured in watts. Compression pressure of an engine will be measured in newtons. Many of the common terms us... in power and energy technology will be changed to the metric system. The metric system will apply to all specifications, basic terms, air systems, lubrication systems, ignition systems, braking and clutching and chassis systems, as well as all other measurements used in and around power and energy systems. Presently many gauges and tools still have the English and metric terms applied. Many of these tools, however, are not using the correct type of S.I. metric terms. For example, many gauges measuring pounds per square inch originally have now been converted to kilograms per square centimeter. These could be converted to pascals in the future instead of kilograms per square centimeter.

SOFT VERSUS HARD CONVERSION

For purposes of definition, it is important to explain the differences between soft and hard conversion. Soft conversion can be defined as changing the measurement of number from an English term to a metric term. A typical example would be to convert one quart of oil to 0.946 liter. No physical difference exists in the container of oil; only the units have been changed. This is contrasted to a hard conversion, in which the actual size of the container is changed to fit a standard even number. The example of a quart can again be used. If 0.946 liter were physically changed to 1.00 liter, a hard conversion would take place. Bolt head sizes have been converted from fractions to 3mm, 5mm, 7mm, 9mm, and so forth. The actual size of the head has been changed. Again, this is considered a hard conversion. Other hard conversions in the field of power and energy are the road signs indicating 90 kilometers per hour. The actual speed in metric of 55 miles per hour is 88.49 kilometers per hour.

In summary, the field of power and ene... s going to be affected greatly by the conversion to metrics in the United States. The more we know about metric units, the easier the conversion to the metric system will be for each of us.

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Miscellaneous Instruction Areas

The Little Man's Approach to Teaching Design

William Paul Anderson

In the age of the computer, numerical control and time and motion studies deluxe, we must provide a time and place of unhurried thought. We need time to plan, for to fail to plan is to plan to fail. Ours is a TV society; what cannot be solved in 30 minutes sometimes takes an hour. Happy endings come on cue.

Life, however, is not that way! Some things take time. Even the shows on TV that end every half hour or hour take several weeks of planning, writing, directing and producing.

In this paper, an attempt will be made to give you some help in organizing these thought processes. What will be presented is not a cure-all or an end in itself. It is a collection of experiences which has been helpful to me, and I hope you will find them equally so.

Though the topic is design, this paper will not be associated with any particular subject such as woodworking, metalworking or printing. It will merely be presented as another tool which you may add to your toolbox of life... a tool that I hope will take its place right beside the saws, hammers, pencils, T-squares and wrenches that most of you see every day.

It is important that the designer have confidence in himself. A STUDENT WILL NOT DESIGN FARTHER THAN HIS OR HER ABILITY TO UNDERSTAND THE DESIGN PROBLEM. This is not an original law with me; I read it somewhere. But the truth of it has been tested over and over and has been proven to my satisfaction.

Basic course work is important if the small school especially is to teach industrial arts courses well. Keep these classes to a workable size; work with your counselor so that this will be strictly enforced. It is important for both students and teachers to understand their limits before any design work is undertaken.

Once these limits are known, develop your ideas one step at a time. A typical thought process can be described as follows:

1. How large is this object going to be? Knowledge of shape and size play an important part in answering this question. Many problems can be solved with pencil and paper before materials are ever touched.
2. Where will it be placed? For example, indoors or outdoors? Should it be painted or stained? Is its purpose beauty or utility, or both? Gather much information at this point; sort later.
3. What purpose does it serve? What earthly function does this item perform? Does my particular design improve its performance?
4. Is it really needed? Wants dominate our lives; needs dictate. Life goes on surprisingly well if needs are met and wants are kept in line. Certain wants are helpful in designing, though after want and need, the question must be asked, "Can I afford it?"
5. Can the product be produced in the laboratory facilities available? Are machines and materials ready to apply to the product or project being designed?
6. Do I personally have the skills necessary to produce this item as designed? Does the instructor have the background to help me with it? Are there sufficient reference materials to provide a resource background for this project or product?
7. Ready, set, go! It's an old maxim but true, "If you can't draw it, you can't make it." The proven three are still the best guidelines. Do you have 1) a working drawing, 2) a plan of procedure and 3) a bill of materials? By keeping these three guidelines in mind, most design efforts can enjoy some degree of success. Keep in mind though, that these guidelines can be flexible.
8. Evaluation — yes, test it under the light of your stated problem or need. How did

the design solution fare? Test it by student, test it by class, test it by teacher and most of all by parent.

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Crossroads—The Aircraft Construction Route to Aerospace Education

William W. Ghan

Ever wish that cup of coffee could last all day? Hate to meet the first class? Is school, school all day long? Are your students bored with the routine? Projects all pretty much the same? Like to liven things up? Then maybe you should try aviation education! With the arrival of the space age, some persons termed aviation education "aerospace education." The technologies are similar—at least from the mechanical viewpoint.

In 1903 the Wright brothers made the first powered flight. Sixty-six years later Aldrin, Armstrong, and Collins landed Apollo 11 on the moon. Has public education made equal advances in aerospace education?

There are 50,000 aerospace industries in the United States involving 350 career fields. No wonder teachers can see students leaving high school and universities...and finding employment with aerospace industries. What aerospace-related education is offered to them in your school?

In Mansfield R-4 Schools, Mansfield, Mo., something is being done about aviation education. Students on both high school and university level are involved.

The following are examples of aircraft constructed by students:

* A miniature biplane named "Scampy," which it is.
* The "Corbin Baby Ace," the first total school project undertaken at Cabool, Mo., in 1966 and which took two years to complete.
* The "Bushby Mustang I," Mansfield's first all-aluminum aircraft project.
* The "Sonerai I," which cruises at 150 mph on a Volkswagen engine.

The "Corbin Baby Ace" was a unique little biplane designed and constructed by high school students. It was the first enclosed cabin, side-by-side seating, two-place biplane in modern times—1968.

You can see what can be done by high school students in the aircraft construction field. Teachers from all over the United States and Canada, participating in an aircraft construction workshop at the University of Wisconsin-Stout, Menomonie, Wis., built a two-passenger yellow "Sonerai II" in just two weeks. This gave teachers a great opportunity to gain hands-on experience before starting a class of their own.

Mr. Rob Hancik, Aviation Director, Springfield, Mo., had this to say about aviation education:

> Reflecting on my personal association with aviation education and the aviation industry for the past 16 years, it is evident that aviation has suffered from not stimulating an interest in the industry through either formal or informal education. It is my observation that the "grass root" interest in aviation and aircraft is virtually gone from the home town airport, with few exceptions.
>
> Excepting the efforts of the Experimental Aircraft Association and a handful of dedicated high school instructors, aviation receives little exposure at a time when young minds are developing. Aircraft construction on the high school level can be utilized as one of the most effective tools in sparking an interest in aviation careers. My own formal education on the collegiate level preparing for an aviation career could have been a more challenging and intriguing diversion from the textbook atmosphere of aeronautics by utilizing the construction of an aircraft.
>
> Aircraft construction on a vo-tech level allows the student to be exposed to many trade skills that might generate an interest in non-aviation endeavors or hopefully aircraft maintenance, a career field which is rapidly dwindling in numbers.

Aviation offers fascinating career possibilities needing only to spark an individual's imagination for a world of opportunities. What more exciting way to stimulate an imagination than through building an aircraft and realizing its flight.

If you feel aerospace careers fit your students' needs, you will want to consider the following:

1. Industrial-technical teachers must have the basic skills necessary for aircraft construction classes.
2. Instructors must have an interest in the aircraft construction approach to aviation education.
3. Instructors must become familiar with aircraft processes and terminology by reading related materials and looking at aircraft.

Formal teacher education can be obtained from aircraft construction workshops at universities. A good reading source is the Experimental Aviation Association and their "Project School Flight." Observation can be made at your local airport, at an aircraft mechanics shop, and at the International EAA Fly-in at Oshkosh, Wis., every August. The EAA has an aircraft project programmed for use at the high school level.

Formal teacher education can be obtained from aircraft construction workshops at the University of Wisconsin-Stout, Menomonie, Wis.; Wayne State College, Wayne, Nebr.; and Eastern Michigan University, Ypsilanti, Mich.

Above all else, the aircraft construction teacher must be an organizer. Mansfield uses the following organizational system, which has worked for 11 successful aircraft projects:

1. Select the project. The project must suit the instructor, the shop and the subject to be taught.
2. Pre-evaluate the educational benefits. Basically, the project must be in keeping with general industrial arts objectives, as well as most of the specific objectives normally applied to the industrial arts area involved. Students must be able to discern its relationship to practical situations, industry and adult life.
3. Protection must be ensured, both for the school and for the personnel.

For example, a project may be financed by an individual. Because students are doing the project and because the project is not for the immediate economic profit of the teacher, school or students, each must seel protection. Students are naturally protected because of their age. The best protection is a mutual agreement on a contract. Items which may be agreed upon in the contract are loss of the project and/or materials by fire or other natural hazards, damage to the project and materials by vandals, loss of the project and materials by theft, the possibility of an uncompleted project at the school year's end, liability in case of accidents happening to students, the teacher, school personnel, the project and the patron, both during construction and after the project is completed, quality of craftsmanship, assurance of supplies when needed and assurance of top quality materials.

Financing is a part of planning. Projects may be financed by an outside source (patron) or be school-financed. In the case of patron financing, the school will naturally furnish certain items that are normally a part of maintenance and operational expenses. These include the teacher, the students, normal tools, textbooks, electricity, heat, shop facility and so forth. The patron may furnish all materials, special tools and special services not normally encountered in the general school shop. Also, this must be done when needed and free of the school's accounting records, so that there will be no confusion during an audit. The patron will risk a large sum of money on the project's successful outcome, so the teacher must instill in the students a sense of economic responsibility related to the project itself.

Administering the project is the job of the instructor; he acts as the liaison between the school and the patron. He must plan the project and then report to the school's principal and superintendent, seeking approval of the total program. The superintendent is responsible to the school board; therefore, he has need for a good report containing all the facts regarding the project.

The teacher must plan ahead when ordering supplies, since once school has started, it is generally too late, especially if one is to have a swift start on the project. All planning and materials lists should be done during the previous school year, but may be done during early summer at the latest. Approval of the project and ordering of the supplies should be completed well before the new school term begins. All supplies need not

be ordered at one time; in order to have them when they are needed, however, one must allow time for shipment of the materials.

The teacher must provide the plans and a work schedule. Working drawings are needed before the materials are ordered, unless the project's requirements are known. Naturally, the work schedule must be related to the school calendar, the number of students, the man-hours required and the amount of classroom instruction normally used for the subject. Even though the schedule will be broken many times and will need revision, serious planning is necessary.

Since the students' education is paramount, the teaching methods and subject matter involved in this project must meet the standards of good instruction. Classroom instruction must not be neglected. The textbook is a tool of any classroom situation. Individual instruction is very necessary, as the student is learning and definitely not just working. Mistakes in craftsmanship must be minimized and always corrected, since this is a basic part of any learning situation. This applies to both classroom and laboratory instruction.

Laboratory instruction is very important and makes up the bulk of the time spent in most industrial arts classes. The students must be made aware of the economic consequences and liabilities of mistakes. Expert and top quality craftsmanship should be promoted in the shop situation. Production quotas must be emphasized, but should not be met at the expense of quality.

In addition to educating the students, it is good public relations to alert the public to the project. The public, and parents in particular, have a right to be informed as to what industrial arts is all about, what is being undertaken, how successful it is, and the persons involved. This information should be supplied as often as your local news sources will allow. Do not neglect school publications, since they reach not only students, but also the adults of the community. Contact the public and take your profession to any place appropriate at every opportunity.

Quality of workmanship is necessary to meet the rigid requirements of the Federal Aviation Administration. FAA inspectors must inspect the plane at least twice: The "precover inspection" before any item is covered and a "preflight inspection" before the first flight. Mr. Graether, FAA inspector, with the Kansas City GADO division, while at Mansfield High School for an official FAA precover inspection of the fuselage fabricated by students, stated:

> The purpose of these inspections is to determine that the aircraft being built is free from unsafe conditions. We will look for poor materials and poor workmanship. We want to see that the best workmanship is done on these aircraft that is possible.
>
> Also, we want to see that the materials that go into these planes are satisfactory and safe. We will look at the airplane to determine that the workmanship is good, and if there is any workmanship that is not good, we expect that it will be corrected. We leave a discrepancy list with the owner or builder so he can make the corrections. If the airplane is satisfactory, we give him permission to close that particular part of the aircraft. We finally give it an inspection before it is flown, after it has been put together, to determine that everything is complete, safety-tested, and that everything is all right.

Aircraft quality is assured by two things: Correct materials and FAA-quality workmanship. Both materials and workmanship standards may be found in the Civil Air Manual, number 18, called "CAM 18." It is available from the Experimental Aviation Association, Hales Corners, Wis.

In giving his opinion about aviation education in the public schools, Mr. Graether stated:

> We have quite a few public schools that are teaching aeronautics. In fact when I went to school myself, I went to Cass Technical High School in Detroit, one of the first high school institutions that taught aeronautics, and it was very complete. I got much out of it, and I believe that was what got me started in my career. I learned much in the high school program that we had. We built gliders, learned how to weld, learned how to machine parts, learned about design, learned about engines and test-work on them.
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> I think it could be increased in the schools. I think there is a lot of interest in aviation.
>
> We in the air explorer post have approximately 15 private pilots who have completed their training and now have their ratings. In face, in just the last two weeks, two of the boys have completed their private pilot's [training] and have received their certificates.

I don't know enough to say [whether] there is enough in the schools or not. I'm not familiar with the rest of the country. However, I think that it could be improved in some of the schools, more information could be given out, and more training in the areas [is] needed. Some of it is glossed over, and not too much actual training [is received] in mechanics. Maybe they just teach about the flying, learn about how to fly, and don't learn the mechanics of it.

I think we need mechanics. If a boy learns it in school, he can go out with a little extra training and start working. He doesn't have to work in the aviation field. We have people who have worked on aircraft engines who go out and work on diesel engines, tractors and other heavy equipment where they are needed. This is the type of training that the aviation field provides. It has served them well because they have been able to get a good job in other fields.

Aviation education, then, is applicable to employment in industries other than aviation. Carrying this idea to the industrial arts shop, we find there can be aircraft projects relevant to all industrial arts areas. There are all-wood planes for woodworking; on the other hand the "Bushby Mustangl" is totally a sheet metal project. Mansfield's "Sonerai" is a mixed construction project with sheet metal wings and a welded truss fuselage. The "Al Bee Sport" combines both wood and metal. It has wooden wings, welded steel truss fuselage, and a lot of sheet metal used on the cowling. There are planes of plastic for teaching this important and widespread technology. All planes use some plexiglass.

A variety of skills from basic to advanced are applied in aircraft construction. You must evaluate these learning experiences both as they relate to your objectives and as they relate to the time schedule needed for the completion of the airplane. We call this evaluation. In the evaluation, the teacher must appraise the progress being made educationally and the project's progress toward termination. This must be continued throughout the program and summarized at the program's end. During the program, one must evaluate the educational objectives completed and those remaining to be successfully mastered. Also, one must keep tabs on the project's progress as related to time. Adjustments must continually be made to meet the educational and practical situations which arise.

At the project's end, about eight important items should be covered in the evaluation:

1. The evaluation should be compared with the original objectives.
2. The students' reactions should be sought.
3. The patron's opinions should be noted.
4. Public reaction is very enlightening if it is obtained objectively.
5. Professional comments of other teachers, in and out of your field, in your school and from other schools, are very valuable.
6. The results of industrial arts competitions should be noted if applicable; however, the results may be misleading to the teacher.
7. Do not forget to add your own reactions, for you know best of all how the class learned compared to previous classes you have taught. Mark it basically a success or a failure and rate each objective as a qualified success or failure. List any other comments or factors that may result from your professional opinions.
8. Do not forget parent reactions — they know their children best.

It is helpful if you find the time to write up the evaluation. Naturally, this is time-consuming, but it is valuable in many ways. For example, you should report the project's success to both the school and the public. You will have undertaken an exhaustive program of definite educational value, and your evaluation will describe the degree of success you have achieved. One should report the evaluations both during the program and at its end. Report to the administration, headed by the superintendent. This may be a verbal or written report, preferably both. If the program is not successful, one may wish to stop here, but the administration should know, regardless. If, however, it is a success, you owe it to your profession, school, students, other teachers, and yourself to tell the world. Do this via public relations.

All this leads up to the test flight. Here is where all the preparation, the work, and the learning is put on the line. The aircraft has passed all FAA inspections. The students are expectant and anxious. The school band strikes up a fight song and the "project" takes off into an element that dreams are made of. It flies ... the climax to a very motivational and exciting educational experience.

Summing up, we can say that aircraft construction, while teaching basic skills, advanced skills, team work, and craftsmanship is motivational and satisfying. This approach, which is both career and general education oriented, is also multi-material and

interdisciplinary. But most of all it is possible for high school students. Why not start such a class in your school? Aircraft construction helped Ken Williams, a typical student, find his place in the world.

> As far back as I can remember, I was fascinated by aircraft. My first real contact with aviation was in a high school aircraft class at Mansfield, Mo. In this class we learned some of the basics of aircraft design and actually built a full size airplane. After high school graduation, I majored in aviation technology at Linn Technical College in Linn, Mo. I am now an FAA certified aircraft mechanic, maintaining private and small commercial aircraft at the Municipal Airport in Farmington, Mo.

Mr. Gahn is an Industrial Arts Instructor, Mansfield High School, Mansfield, Mo.; Suooly Instructor, Southwest Missouri State University, Springfield, Mo.; and Aircraft Construction Workshop Instructor, University of Wisconsin-Stout, Menonomie, Wis.

The Computer and Emerging Applications to Industrial Arts Education

Ronald McGrath

Most of us grew up when modern computers were not in existence. While the same situation might have applied to automobiles in the early twentieth century, a fairly rapid change took place then. Even if not everyone drove an automobile, almost everyone had a friend who did. Automobiles quickly became common on our streets, and their principles of operation were relatively simple and easily understood. Unfortunately, today the average person does not have the foggiest idea of just what a computer is or how it works. Their only contact with computers may be with the telephone bill, an income tax return or similar bus ess form; so too with the professional educator. There is a need to know, to understand the operation of the computer and how it may be applied to industrial arts education.

The purpose of my presentation today is: (1) to present a brief description of how a computer functions, (2) to describe the parts which make up a computer, (3) to show how a simple flow chart operates, (4) to write a simple program, and (5) to demonstrate practical programs which can be utilized to solve problems in industrial arts classes.

To give you just a brief background into the history of the computer, we might begin in 1946 when the federal government, while testing nuclear devices, employed a staff to do the mathematical computations. The staff of 20, working on 17 IBM machines, worked to solve problems 24 hours a day, 6 days a week, for a full year. In 1959, a computer was produced called the LGP-30. By today's standards, this machine was small and very slow; it took milliseconds to carry out its computations. Today all the computations conducted in 1946 can be carried out by a college freshman in one afternoon, while 100 other people are using the same computer.[1]

There are four special characteristics of all computers. The single most important feature of a modern computer is its incredible speed.

The computer works, as we shall see, one step at a time. These are simple steps which any high school student can do, but the difference between the student and the computer is vast. The computer is able to do a million or more steps in a single second! Some computers can add as many as 250,000 16-digit numbers in one second. As a rough rule of thumb, a computer is a million times as fast as a human being.

The computer can also remember both facts and instructions. This stored information can be put to use in a split second; and, unlike the human memory, the computer never forgets. Think how smart you'd be if you could remember every fact you had ever read or been told — instantly!

Because of its fantastic speed, the computer can solve problems without reduction; hence, the most accurate way. For example, a computer can easily divide 6.1382313290 into 23.5439189113. By contrast, most people working the problem by hand, would probably reduce the problem to 23.5 divided by 6.1.

The fourth characteristic of a computer is that it works automatically. It can remember a set of instructions, and it can execute these instructions in the proper sequence without human direction. If you were a computer operator, for instance, you could feed instructions into the computer, then go to lunch, paint a picture, or read a book. The computer would work automatically, step-by-step, figuring a solution to your problem.[2]

There are five basic components which make up a computer: input, storage, calculation, output and control.

INPUT

Gathering the facts so you can use them is basic to input. With a computer, you "feed" in basic information so the problem can be solved. The devices to do this would be, for instance, a tape reader, punched card reader, or communication lines.

STORAGE

Keeping the pertinent information available for ready use in working a problem is called storage. The computer has a memory which stores both information for solving a problem and instructions on how to use the information.

CALCULATION

The third basic component is calculation. Simple problems can be worked with pencil and paper or on an electronic calculator. The computer's calculating, or arithmetic, unit operates on the same principles as an adding machine. It can add, subtract, multiply and divide.

OUTPUT

With any problem, the facts are gathered and worked until the answer is solved. For the computer, output is the act of taking answers out of the computer or delivering the answers after the problem has been worked.

CONTROL

Control simply means doing things in the proper order. When you work a problem, you subconsciously do first things first; an example might be balancing your checkbook. You look at the records, enter the deposits, enter the amounts of all checks written, and so forth. The computer must also be guided every step of the way. This is the job of the computer's control unit.

Now, in order to guide the computer in this step-by-step process, a computer program must written. An important guideline in writing computer programs is that one must think out ahead of time exactly what results one expects to obtain from the computer and what computer results need to be printed to enable a conclusion to be reached. A computer is helpless until it has been given a detailed set of instructions. The computer can't figure out how to solve problems. All it can do is laboriously follow directions step-by-step until the job is completed. This is true for any problem, no matter how simple or complex.

To write a program, we must first understand the problem to be solved. We must analyze it and break it down into its components. One way to do this is to construct a flow chart of the problem. This is a line diagram showing the component parts and how those parts fit together. Each part of the flow chart must be broken down into simple instructions. From the flow chart, then, a program is written. Each line of a program is called a "program statement."

Boxes in a flow chart represent work to be done; diamonds, choices to be made. Decisions may be expressed as answers such as "yes" or "no," "true" or "false." If the answer is "no," the program may skip several instructions and go on to another part of the program. This action of skipping is called "branching."

Once the problem has been mapped out in flow chart form, and broken down into individual simple operations, we must write the instructions telling the computer how to handle each operation — but here we run into another problem. The computer does not

understand English. We have to write our instructions, the computer program, in a language, or code, that the computer can understand.

For example, before arriving here at the convention center you had breakfast at one of the downtown restaurants. After scanning the menu, you order two eggs on toast; the waitress shouts toward the kitchen, "Adam and Eve on a raft!" Or you may be familiar with another order: "Good morning, Miss, I would like to have a bacon with lettuce and tomato sandwich on two slices of white bread that are toasted, please." And the waitress calls, "BLT Down!" Just as restaurant workers talk to each other in a special code because it is short and precise, computer programmers use special codes for the same reasons.

Today, almost anyone can learn to use a computer, thanks to symbolic language. There are several languages written for this purpose. At the present time 98 percent of all programs, including those written by experts, are in the BASIC language. Other special languages, such as FORTRAN, COBOL and ALGOL, make it easy for businessmen, scientists and engineers to write programs using words and symbols associated with their work.[3]

Industrial arts instructors have a practical need to understand and use the computer. For example, most of us have taught a woods class at one time or another and can appreciate the problems junior high and senior high students may have in determining the total board feet and the cost of a project.

If a student were to use a computer, he first gets the attention of the computer at the teletypewriter. The computer "asks" the student if he has a bill of materials. If the student has the necessary information, he types the data into the computer and, when completed, the computer prints: "THE TOTAL BOARDFEET OF YOUR PROJECT IS ____. THE COST OF LUMBER IS $____."

Another program can be used to check the results of a problem in an electronics class. For example, a series resonance current and impedance circuit problem. This would take two students four hours to set up and measure the voltages across three separate devices at varying frequencies, then to tabulate the currents and impedances at these frequencies, and construct a graph to plot the resonant frequency and locate the bandwidth. With the necessary data available, the computer, utilizing the ASR33 teletypewriter, can solve the problem, giving all information in merely ten minutes.

Whether it is woodworking, electricity or mechanics, as teachers we can introduce high school and college students to meaningful, practical applications of theory as it is taught in class.

Students will want to "play around" with the computer; they will start writing their own programs and teaching other students how to program in the process. The student becomes the teacher and the computer, the student. The student must concentrate on the basic principles; he must have a clear understanding of the problem to be able to explain it to a computer. As students gain programming experience and sophistication, they will attempt more difficult problems.

More and more educators should have basic understanding of at least one programming language such as BASIC or FORTRAN. A programming course designed for the professional educator — not for the mathematics of engineering major — would be most desirable.

I would like to close with a quote from Ben Schneider, Professor of English at Lawrence University:

> It may be that without computerization our institutions cannot survive the overpowering onslaught of facts that modern civilization produces and demands attention to.
>
> As the world increases in numbers and complexity, our need to know becomes greater, and so does the difficulty of finding out.
>
> Because of the part played by computer techniques in coping with the pressure of numbers, some understanding of computers ought to characterize every truly educated man in this century. Even to cope with the dangers of misused computing power (as in a police state), an understanding of this machine is a requirement.[4]

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Plastics—Yesterday, Today and Tomorrow

Louie Melo

In any discussion of plastics, it seems appropriate to review some common reactions that have prevailed for as long as people have used materials in general to satisfy their industrial and personal needs.

Historically, people's early basic needs were met by utilizing readily available natural materials. History also tells us that when a particular material could no longer meet existing needs and another natural substance was not readily available, the human drive toward developing or formulating a substitute measurably increased. This merely means that during the last several thousand years, materials for application in agriculture, clothing, manufacture, housing, transportation, safety, self-protection, communication, entertainment and others were initially natural materials. As these supplies dwindled and/or additional needs emerged, the interest in new, modified and/or synthesized man-made substances grew.

THE GROWTH OF PLASTIC INDUSTRY

The plastic industry began about the middle of the 19th century when natural ivory could no longer meet the needs of the billiard ball market and a $10,000 prize was offered for a suitable substitute. Mr. John W. Hyatt, a printer, has been credited with the development of a new acceptable synthetic material (cellulose-nitrate) that in turn was treated with camphor, heat, and pressure to obtain properties that closely resembled natural ivory. Soon after its introduction, this new synthetic material gained increased attention. For example, it began to replace hard rubber used by dentists and found its way into photograph film, plastic sheets for auto curtains, shirt cuffs, collars, combs, eye glass frames, and many other industrial and home use items. The new man-made "celluloid" seemed to have started a chain reaction toward new synthetic materials. The thermoplastic and thermosetting plastics industry began its growth as another branch of the industrial materials tree.

The industry grew rapidly. Additional plastics included: phenol-formaldehyde, 1890; casein, 1919; alkyds, 1925; cellulose acetate, 1927; styrene, urea formaldehyde, vinyl family, acrylic, 1931; cellulose acetate butyrate, 1932; polystyrene, vinylidene, 1927; melamine formaldehyde, ethyl cellulose, 1939; polyethylene, 1942; silicones, 1943; and many more. Synthetic plastic is now a multi-billion dollar industry and has earned its rightful position as one of the several major families of industrial materials.

For example, prior to 1940 the typical automobile was largely metal. Its major interior upholstery was made from natural animal or fabric material, and parts related to the electrical system were using less than 5 pounds of synthetic plastic per car. By 1976 the average car contained 175 pounds of various plastics. By the year 2000 this figure is expected to reach 800 to 1,000 pounds. Already designers are thinking in terms of large exterior and interior body assembly molds as single units. This would reduce vehicle body weight by 1,800 pounds, as well as substantially reducing manufacturing costs without sacrificing riding space or comfort. Plastic materials are also in the future for other industries such as the beverage, packaging, furniture, housing, portable homes and electronic industries.

CURRENT PLASTIC TRENDS

While the growth in the use of plastic resins has reflected a steady, positive demand pattern, the availability and rising costs of the basic raw material (crude oil) has intro-

duced a new set of problems. During the 1973-75 period, the plastic industry faced a severe crisis as crude oil shortages and extensive price increases caused many plastic fabricators to accept less raw material. These severe pressures caused the industry to reassess the utilization of the basic resins. Fillers, bulking materials and binders received more attention than ever before, and thus a new era referred to as "polymer blending and composite plastics" was begun and expanded rapidly.

In short, the present period is one of reducing the quantity of basic resin when preparing molding material through the use of selected fillers, particulates, spheres, flakes, fiber binders, foaming agents, and other "modifying" substances. The indication is that future plastic technology will, in effect, employ the resin as a binder for the selected composite mass, much as asphalt is used to bind road bed aggregate. Current indicators seem to point toward a nearly unlimited array of improved functional properties including strength, hardness, expansion, resistance to various operational environments, and other assets. For example, tests using polypropylene resin have already enabled composite clenders to increase tensile strength by 60 percent, flexure strength 100 percent, heat deflection by over 90 percent and expansion reduction to nearly the expansion rate of common non-ferrous metal.

In addition, flame retardants, smoke suppressants, and other chemical compounds for safety purposes are being employed, as well as ultraviolet and microorganism sensitive fillers that will promote natural degradation or destruction of the composite polymer when it is exposed to the outdoor environment for a reasonable period of time. This would result in the self-destruction of such material as bottles, food wrappers and cartons.

DESIGN AND MATERIAL SELECTIVE CONSIDERATION

Almost all designers and/or manufacturers of consumer goods are faced with material selection problems. Since the plastic industry has become a viable part of our modern materials pool, it must be evaluated and scrutinized along with other material families. Some major questions that must be answered involve an understanding of the proposed object itself and also the performance parameters and the physical and mechanical environments that the object and/or material will be exposed to. In selecting materials, some of the variables to consider are:

1. Specific gravity (weight to volume) as it relates to a portable or stationary product.
2. Thermal conductivity properties as it may apply to product performance.
3. Thermal expansion as part of its performance and design parameters.
4. Moisture absorption limits when exposed to operational environments.
5. Resistance to abrasion.
6. Corrosion design.
7. Flammability.
8. Potential toxic problems during fabrication and usage.
9. Expected dynamic, static, and impact stress.
10. Elongation and creep due to stress exposure.
11. Flexible strength.
12. Hardness over its operational temperature range.
13. Dielectric values.
14. Fabricating properties.
15. Maximum environment or operational temperature.

This unique family of man-made materials can and do meet some very specific product needs which other materials cannot. Even though plastics cannot approach the strength and hardness of metals or the light weight of most woods, many do offer more than adequate strength, light weight, flexibility, levels of transparency, corrosion resistance, greater simplicity in manufacturing, close tolerance control, little or no added finishing after molding, a wide range of surface finish and/or treatment and color, as well as low cost. Selecting plastic necessitates a careful review of the desired properties as they relate to the proposed product.

The "Plastic Elastomer Reference Issue" published bv Machine Design presents a range of design and material considerations in a very concise and effective manner. Using the prepared diagrams, graphs, and tables, the educator or practitioner may quickly identify the most plausible material for the design problem at hand.

For example, the series of graphs can quickly provide the designer with the opportunity of first comparing plastic to metals in terms of such basic properties as tensile

strength, useful temperature range, dielectric strength, thermal conductivity, thermal expansion, specific gravity and others. In effect, the designer can quickly determine if a thermoplastic, thermosetting, ferrous or non-ferrous metal will meet his design requirements.

Detailed information about the particular major thermoplastic and thermosetting polymer is provided. In addition, other similar graphs and selected tables provide data of modified or composite polymers that could possibly meet required specifications.

This method of selecting a polymer for a particular problem seems to be educationally sound and can be used in the educational program. Such a systematic review and evaluation should permit the designer or educator more adequately to describe and identify a plastic that will meet his requirements.

THE INDUSTRIAL EDUCATOR'S ROLE AND RESPONSIBILITY

Since its introduction a century ago, the plastic industry has experienced numerous growth problems; however, it is now a viable part of the industrial world, with polymeric (plastic) materials now in use in nearly all industries.

During the last several decades alone its industrial growth has averaged 15 percent per year, and all indications seem to point toward this continued level of growth. In fact, "Plastic Education Guide" predicts that within the next decade the cubic volume of plastic materials produced will exceed that of metals. The Plastic Education Foundation, cooperatively working with the Society of Plastics Industry, Inc., published this guide. Other plastic-oriented researchers have indicated that by the year 2000, we will be using nearly 35 million tons of polymer materials per year.

As the plastic industry continues to grow and its operational parameters expand to include multi-polymeric blending and the extensive use of modified and/or reinforcing composites, the need for properly trained or educated personnel will be an important part of its vitality and growth. In short, the industry, through the Plastics Education Foundation, is committed to helping educators to develop a viable and relevant program in plastics. Current data indicate that as of this date the number of such programs is still not adequate.

CONCLUSION

When reviewing the broad spectrum of the plastic (polymer) industry, it seems apparent that plastics has earned its rightful place alongside other major materials. Current data indicate that some educational institutions have oriented and directed their plastic offerings toward current and future industrial plastic needs; others have not. Many industrial educators are still treating plastics as an area which involves only sheet and bar stock which is used to fabricate small utility and/or decorative objects.

In addition to an understanding of the material itself and design and manufacturing considerations, the future educator must also develop an understanding of environmental considerations as they may apply to its manufacturing and use. Questions related to toxicity, combustibility, reactivity to varying exposures, safety during all operational phases and other ecological considerations should become a significant part of the total program.

For instance, plastic materials that come in contact with food and beverages must be approved by the Food and Drug Administration (FDA). Current estimates indicate that by the year 2000, some 237,000 tons of plastic will be subject to such reviews. Also, all working or manufacturing environments, including school laboratories, will be subject to safety inspection by the Occupational Safety and Health Administration (OSHA). Fumes and other gaseous materials emitted during molding, mixing, cutting, machining, and other operations will have to be closely monitored.

Tomorrow's educator must be able to help his students differentiate between facts and emotions or hearsay. As a start, every school should be equipped with a Dangerous Properties of Materials handbook for ready reference.

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Optoelectronics

William H. Rigby

After a slow start more than a century ago, the optoelectronics field has become one of the fastest growing segments of the electronics industry. Optoelectronics is frequently defined as the combination of optics and electronics as found in light-emitting diodes (LED's), photodiodes, phototransistors, optocouplers or optoisolators, and both numeric and aplhanumeric displays. This presentation will describe these devices, their operation and application.

The mainstay of the optoelectronic field is certainly the Solid State Lamp (SSL) or Light Emitting Diode (LED). The LED is a PN junction semiconductor device much like a conventional semiconductor diode. However, the LED has been designed specifically to emit light through a glass or plastic window forward biased. As with any forward biased diode, electrons flow from the negative to positive regions. In the LED the recombining of electrons and holes in the P region brings about the release of energy in the form of photons of light. To achieve this release of light, the familiar semiconductor materials of germanium and silicon are replaced by gallium and arsenic in the form of gallium arsenide (GaAs).

The amount of light emitted by an LED is directly proportional to the forward current through the PN junction. Typical operating parameters for LED's are forward voltages of approximately 1.6v and forward currents of 20mA. This low voltage and moderate current serves as a major advantage for LED's over discrete incandescent lamps, but it also must be dealt with when using these devices in actual applications. For example, a typical application for an LED might be as a pilot light in a 5-volt TTL circuit. Care must be taken to observe the limitations, as currents in excess of specified values will permanently damage an LED.

A second popular application for LED's is that of logic level indicators in digital circuits. These devices are well suited for this application due to their low current requirements and compatibility with common logic families. Individual LED's are compatible with TTL IC's and require no additional drive circuitry.

In addition to low voltages and currents, a second major advantage of LED's is their long life expectancy. Most manufacturers claim a useful life expectancy for their LED's of 100,000 hours. Using this figure, an LED used in a piece of equipment operated 24 hours a day, 365 days a year, would last over 11 years. From a practical standpoint, it can be assumed that an LED will last the lifetime of the circuit.

Initially only Red LED's were availabl , however, recent technological changes have brought about the development of Orange, Green, and Yellow LED's. While LED's are produced in many styles and package configurations, a few styles stand out as industry favorites and, therefore, are commonly available. The T-1-3/4, a 1/4 inch diameter, high dome epoxy package, has dominated the field and is produced by most manufacturers. The MV 5020, MV5021, and MV5023 manufactured by Monsanto are typical of this style LED. As with conventional diodes, manufacturers designate or indicate the cathode end of LED's. The cathode lead on an LED is identified by a flat chamber on the plastic case or by one of the two leads being shorter.

The many electrical and practical advantages of LED's over conventional incandescent light sources can be summarized as (1) long life and ruggedness, (2) low impedance, (3) small size, (4) very fast response time, (5) the absence of filaments or heaters, (6) low power consumption and (7) light weight.

An extremely popular use of light emitting diodes is for numeric readouts. These devices are available in a wide range of sizes, configurations, and colors. Currently the most popular size is the .3 inch character height. Other character sizes are .63 inch, .25 inch, and the .11 inch found in most portable calculators.

A major distinction between readouts is the internal connections of the LED's within the display. The two versions available are Cathode and Common Adnode.

The Common Adnode display requires "sinking" inputs to activate the segment, while the Common Cathode requires a positive voltage to light its segments. This distinction obviously requires two different Decoder/Drivers, and care must be taken to select the correct driver IC for a particular readout configuration. The figure below indicates some typical readouts and their configurations.

Device	Height	Manufacturer	Type	Driver
DL 707	.3"	Litronix	Com. Anode	7447
DL 704	.3"	Litronix	Com. Cathode	7448
DL 1A	.27"	Litronix	Com. Anode	7447
DL 747	.63"	Litronix	Com. Anode	7447
Man 1	.27"	Monsanto	Com. Anode	7447
Man 7	.3"	Monsanto	Com. Anode	7447
SLA 1	.27"	Opcoa	Com. Anode	7447

TYPICAL DISPLAYS

As with discrete LED's, there is a 20mA current limitation per segment with these seven-segment displays. Typically a 100 ohm or 120 ohm resistor is inserted in each segment line (a-g) to provide current limiting. Failure to insert these resistors will permanently damage the LED readout.

A third major segment of the optoelectronic field is the opticalcoupler. Known variously as optocouplers and optoisolators, these devices represent a new growth area of the optoelectronic market.

Used primarily for interface applications, the optocoupler consists of an LED and compatible photodetector paired so that the light created by the activated LED will be optically coupled to a light-sensitive detector. Designed to replace transformers and coupling capacitors in digital and linear interfacing applications, these circuits exhibit many times the isolation voltage of the older devices and yet retain small size and low power consumption.

The basic optocoupler consists of GaAs LED optically coupled to a photo-sensitive silicon detector, which may be a diode, transistor, darlington transistor, SCR, or triac.

Frequently, both the LED and the detector are contained in the same package, though some units are not sealed and operate in conjunction with an optical path through an air gap. This air gap permits the use of physical devices such as gears, cams, and so forth to interrupt the light path, causing desired changes in the circuit. Attractive characteristics of optoisolators include: (1) The electrical isolation of an electromechanical relay, (2) The speed of a semiconductor, and (3) The long life and low power of a semiconductor. Many applications suitable for the optocoupler involve the triggering of high voltage, high current SCR's from low voltage circuitry.

Optoelectronics has many applications and represents a new and growing field. In the next few years optoelectronics is certain to exert a greater force in the electronics industry. Any reasonably contemporary industrial education or technical electronics program must include the "Opto's."

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Marketing: A Part of a Manufacturing Unit?

Donald F. Smith and Thomas Wright

Manufacturing means many things to many people. For our purpose, manufacturing will be defined as all those activities associated with utilizing resources to produce products which are sold in the marketplace with the intent of making a profit for the owners of the enterprise. Manufacturing has two major components: Material processing and management.

Material processing includes all man's knowledge and activities designed to change the shape, composition, or combination of materials, parts, or subassemblies. Material processing utilizes six families of processes: casting and molding, forming, separating, conditioning, assembling, and finishing.

Management includes all the efficient practices used by man to plan, organize, direct, and control areas of activity within the enterprise. Manufacturing management coordinates five major activity areas which are as follows:

1) Research and Development: scientifically seeking and discovering knowledge about products and processes.
2) Production: planning for and producing authorized products which meet stated quality standards.
3) Marketing: encouraging and facilitating the flow of goods from producer to consumer.
4) Industrial Relations: insuring that the relations between the company and its employees and public are positive.
5) Financial Affairs: directing and controlling the company's monetary operations and securing necessary materials, supplies and equipment.

MANAGED ACTIVITY AREAS

The first three activity areas (R&D, Production and Marketing), are directly involved in the movement of the product from idea to profit. The associated activities are, therefore, considered essential components of a complete study of manufacturing. These managed systems are an integral part of the transformation of an idea into a product which is hopefully converted into money. The other two activity areas support the movement of the product and are therefore included to add intelligibility to the product-centered areas.

The essential elements of the manufacturing enterprise which summarize the task of manufacturing management can be summed up in the following sentence: Management uses resources of men, machines, materials and money to produce products which are converted at the market into money.

MARKETING

A complete study of manufacturing must include a study of marketing. Marketing includes at least four basic functions or components. These are:

1) Market Research: scientifically seeking and discovering information about markets and marketing activity.
2) Advertising: presentation and promotion of ideas, products and services paid for by a sponsor.
3) Sales planning and operation: planning for and exchanging products with customers for money.
4) Distribution: moving the product from the point of storage to the point of use.

The work or activities associated with these marketing functions are complex. The major sub-functions under each of the marketing functions include gathering and analyzing information as part of market research; developing, designing and placing the message as part of advertising; planning and carrying out sales; and channeling and inventorying as part of distribution.

MARKETING ACTIVITIES IN THE STUDENT ENTERPRISE

The marketing activities described are used in the manufacturing program at Ball State; however, the concepts and methodology are easily applicable to programs in the middle, junior high or high school. Basic to this program are creative student activities planned within the conceptual framework of the program. These concepts are presented in detail during class lectures using transparencies, slide series and other media. This structure is then used as a guide by each "company" as they develop marketing plans to fit their product and situation.

In industry, the market research function often provides data including information about potential products, styles, markets, and sales. In our program the market research

activities begin during the research and development phase of the student enterprise. Consumer reaction to potential products is obtained through market surveys. The following questions are usually answered through the surveys:

- Do the potential consumers like the product?
- Will they buy it either for themselves or as a gift?
- Would they make changes in the product?
- How much would they pay for the product?
- Who are the consumers?

The results of the market surveys are used extensively in selecting products for manufacture in the student enterprise.

The production quota for the various companies is usually set at a minimum of 100 products. This quantity tests the efficiency of the production department's line, and it also challenges the marketing department to develop effective advertising, sales and distribution systems.

The advertising group's work includes developing a theme for an advertising campaign. The responsibility for developing the company name, logo or trademark and slogans usually rests with this group. These are then used in the design of a creative advertising campaign which attempts to make the product known to a large number of persons and to lead to the sale of all products produced. Typical questions asked by the advertising group in the course of developing the program are the following:

- Who is the market?
- Where is the market?
- How do we attract potential customers?
- What media do we use?

Usually two or more media are chosen for this purpose. Some typical media include posters, fliers, displays and radio advertisements.

Another function related to advertising is package design. Since the package utilizes much of the data developed by the advertising group, it can actually be considered a medium for advertising. Therefore, packaging usually is designed by this group. The actual production of the packages is either done in advance of the production run by the advertising group or is planned by this group and made by the production department as a part of the regular production run.

One of the initial responsibilities of the sales group is to determine the selling price of the product. This is accomplished after obtaining data from several sources, including the survey results and cost data collected by the financial affairs department. Some quesrions that assist in establishing a selling price are:

- What did potential consumers say they would pay for the product?
- What are the actual production costs?
- What are the overhead expenses?
- What are the marketing expenses?
- What should be the return on investment to the corporation's owners?

Sales quotas are established for the salesmen (all members of the class), and they are trained. The training program is a formal one, complete with a kit for each salesman including a training manual and sales receipt book. Sales office records include progress charts posted to show daily individual sales and total company sales. Sales incentives include a sales commission for all products sold, plus other incentives and awards.

The "direct" distribution channel is normally used in the student enterprise (factory salesman to customer). However, products have, on occasion, been sold to retailers. The distribution activities are, for the most part, concerned with inventory control. Systems and procedures are developed for salesmen to obtain products from the warehouse. These systems must be designed to function in concert with the sales office records so that inventory control is maintained.

SUMMARY

The title of this presentation asked the question: Should marketing be a part of a manufacturing study in industrial arts? We firmly believe it should be. We are studying

how industry produces products to make a profit, and that profit is made by marketing those products. If we are indeed activity-oriented — learning by experiencing — it seems logical that marketing is a very important part of a manufacturing unit. In fact, it is just as important as research and development and production. To omit marketing, an essential element in manufacturing, in the study of industry would seem to be doing a disservice to our students and result in a less than adequate conceptual structure of manufacturing.

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Past, Present, Future

An Era of Growth—The Junior High/Middle School Industrial Arts Programs, 1909-1976

C. Kent Allen

THE FIRST JUNIOR HIGH/INTERMEDIATE SCHOOLS AND INDUSTRIAL ARTS

The foundation for the junior high and middle school was initiated before 1900. The date often given for the increased interest in this education reform was 1888, the year Harvard's President Eliot addressed the National Education Association and expressed the opinion that American education was not meeting the needs of society. He suggested a certain amount of reform was in order. Segments of the traditional curriculum were to be eliminated; the school day was to be lengthened; and the administrative structure was to be altered.[1]

By 1909/1910 the necessary foundation had been laid for the first intermediate schools. The reform committees had publicized the needed philosophy; and researchers, such as Ayers, Strayer and Thorndike, had pointed out facts and concerns about school dropouts, retardations and learning abilities. Accidentally, and by design, all the elements needed to develop a new segment of American education were ready.[2] The beginning of the junior high school movement was relatively easy to segregate from the whole of American education. However, establishing which school system in the country first introduced the intermediate/junior high per se was rather difficult.[3] Columbus, [illegible] and Berkeley, California, [illegible] ations of the junior high school movement [illegible] with the 6-3-3 plan. In both Berkeley and Columbus attempts were made to embody the best recommendations of educational leaders.[4] At this early stage of development the term "junior high school" was not a universal term describing the educational unit between elementary and high school. Berkeley called their new structure the Introductory High School, and Columbus called their new school a junior high school.

A great deal of educational thought and activity preceded the eventual development of industrial arts in the early junior high schools. To make the American educational fields properly cultivated and fertile for the seeds of reform, a long list of men struggled to offer their ideas and philosophies. Great men such as Locke, Rousseau, Fellenburg and Pestalozzi contributed ideas and action in Europe that eventually exerted influence on American educators.[5] Early efforts of manual education were encompassed and influenced by a variety of ideas and efforts.

Manual training as an early form of industrial arts was introduced by Woodward and Runkle as handwork for schools.[6] These two men represented educators interested in giving youth certain kinds of experiences through school-supervised, manual training programs. It was asserted that educators should step into these areas of study because of social changes brought on by industrial progress and a changing economy.[7]

One other influence upon early industrial arts was that of Swedish sloyd. Otto Salomon,[8] the primary developer of Swedish sloyd, claimed the purpose of the system was not to produce carpenters, but to develop in children mental, moral and physical powers. To achieve his goals Salomon set forth the formative and the utilitarian aims of sloyd.

To this point manipulative activities had been discussed only in the broad scope of general education. However, during this period of educational reform there was a great deal of sympathy for prevocational education as it might possibly be offered to the upper grades of the elementary school: 6, 7, and 8. The purposes of many efforts were to hold the youth in school as long as possible, to keep the door to high school open, and to give preliminary aid in the preparation for an occupation. There was a great deal more to the prevocational emphasis than met the eye at first glance.

Sympathy was generated for the idea of establishing programs of study to be tailored to the needs of those students definitely planning to leave school at the completion of the 8th grade. Students were to have the opportunity to gain understanding of the conditions to which they would be exposed after discontinuing their education. When the students left school, they would then be "better able to cope with the unfortunate conditions and to work through them to something better."[9] This prevocational course would have a double purpose, to deter those who would and to assist those who must leave school at 14 or 15 years.[10]

Whatever the program, manual training, sloyd, or prevocational, the manual-oriented school activities were firmly entrenched in the public school system of the early 20th century. The United States Bureau of Education[11] noted that nearly half of 671 cities of more than 4,000 population had manual training taught in their schools. The number was increased from the 1890 figure of 37. Of those offering a program, over 75 percent included the program in grade 6, 7, 8, or 9. In 1908 the practice of having manipulative activities included in grades 6-9 was soon to become a part of the intermediate school movement.

CONFUSION AND A UNIQUE CONTRIBUTION (1909-1929)

With the development of the new program between elementary and high school, there was confusion. From the opening of the first schools and through the 1920's this intermediate school idea was accepted by most educators. However, local districts established schools as defined by local needs.[12] The intermediate schools established in 1910 at Berkeley and Columbus illustrated the confusion, even with names.

To add to the confusion of the junior high/intermediate school was the variety of definitions for this segment of education. The junior high was often defined "as an organization of grades 7 and 8 or 7 to 9 to provide by various means for individual differences, especially by an earlier introduction of prevocational work and of subjects usually taught in the high school."[13] This was only one of several different concepts of the early junior high school. Other educators offered a variety of ideas for a definition and eventually a consensus was drawn.

One of the influences on the development of programs for the intermediate school was that of students leaving school early. Even though child labor and attendance laws had been established in New York for 16 years, several thousand students were leaving school before age 14.[14] "Two-thirds of the children who enter the elementary schools in the United States drop out of them and end their school work before or by the time they have reached fourteen years of age."[15]

Another point affecting the establishment of programs was that school people started

to recognize individual differences in students. More and more educators said that "traditional practices of acceleration and retardation needed supplementing if the schools were to provide adequately for individual difference."[16] It was further noted that the work of G. Stanley Hall, J. McKeen Cattell and E. L. Thorndike gave impetus to establishing schools for children and to children's individual needs.

The first junior high schools were experimenting with curriculum and the kinds of programs that best suited adolescents in different communities. Many of the students not entering high school were destined for the world of work. With this in mind certain manual activities were suggested to help the student gain powers of observation and understanding of materials, processes and procedures.

Confusion within industrial arts as it developed in the junior high was illustrated by the fact that early shop-oriented, manual activities were not all titled "industrial arts." Administrators, students, teachers and communities were forced into confusion by the use of four terms intended to title manual activities for junior high age boys. "Manual training," "prevocational," "manual arts" and "industrial arts" were names to encompass a specific program. In 1909 each name and supportive philosophy had its supporters. By 1929 a single term "industrial arts" was used to describe most shop-oriented, manual activities.

Manual training at the time of the first junior high schools was an important influence on industrial arts as it was to become part of intermediate school.[17] Bawden believed the aims of manual training of 1913 to be fourfold. The first aim was involved with a broad preparation that was to be related to vocational education. Second, students were to be given an opportunity to do something with their hands. A third aim was that of cultivating an appreciation of mechanical things and quality workmanship. The last aim was that through participating in manual training, students would gain insight into certain trades and their potentials in that trade.

This shift towards industrializing manual training was justified because of the change in society and its needs. "The pressure of economic necessity... makes it imperative for many to leave school early in life, and for this class something more than the purely cultural value should obtain."[18]

In the 1920's this variety of manual training was a popular and thriving part of junior high school programs. However, certain segments gradually changed emphasis from vocational education objectives toward general education and industrial arts aims. This new position included the gradual movement from prevocational and vocational education for manual training toward general education and exploration for handwork subjects. Melvin Barlow summarized the plight of manual training when he noted that "times were indeed changing in the mid-1920's. It was necessary for manual training to recognize that it must adjust or suffer grave setbacks."[19]

Several prevocational programs existed before the junior high movement was implemented into school districts. As the junior high established itself, the prevocational curricula found a temporary home in certain schools and districts. After 1910 a district educational profile developed for this variety of handwork.

This included having boys and girls participate in classes designed to help each student make a specific vocational choice. Once a choice was made, a program of study was followed to help the student achieve skills needed to enter an occupation. Certain junior high schools established production situations in which students participated as learners and workers. Supposedly, a student could enter a job after leaving the junior high school. The hope was that students would go into a "higher school, preferably technical."[20]

As prevocational education in the junior high movement continued into the 1920's, F. P. Butler[21] maintained that prevocational and junior high concepts complemented each other. However, his concept of prevocational education was different from the early supporters of 1910. He claimed boys of junior high age were not ready to choose a specific occupation in the industrial or the professional area. The junior high schoul constantly help the student expose himself to new experiences and occupational choices. These basic concepts of prevocational programs at the junior high level had been forced to change with the times or to be eliminated from the curriculum, just as manual training had been forced to change or be dropped.

Charles Bennett attempted to identify the place of manual arts in education just after the establishment of the first junior high schools. He believed education had broadened and as a result had acquired a degree of confusion. This confusion had not circumvented

the area of manual arts. "The motives for the introduction of these arts have come to be so varied that to think clearly concerning this phase of school work is very difficult."[22] This confusion was credited to the changing social ideals and the "failure of educators to recognize the manual arts function in school education both in attaining the end of education and in facilitating the educative process."[23]

With respect to manual arts in general education, manual arts had four objectives. First, it was a factor in developing social efficiency in students. Manual arts strove toward, and contributed to one's ability to function within his social surroundings.

The second major objective was the role of manual arts in accelerating the educative process. This process was made up of indirect and direct means of helping students gain experiences. Manual arts gave students direct educative experiences by using a variety of shop-oriented programs.

Third, manual arts strove toward being a subject and method in the education process that allowed learning through activity with tools and materials.

The fourth general objective related the function of manual arts in primary, grammar and high school education. For the upper grammar grades (7-8), technique was very important. At this age it was considered important to correctly direct and develop the young student's shop work techniques lest they fall victim to poor habits and procedures of work.[24]

In the 1920's, many educators became confused about manual arts in the junior high. Ryan[25] emphasized and gathered support for the idea that general training and vocational training were confronted with confusion in the education world. Selvidge[26] summarized the plight of shop teachers in the junior high when he said they had been harassed by theories, surveys, criticisms and inadequate provisions. He suggested that the way out of this dilemma was to specify what the child was expected to know and do after a unit of instruction. In addition it should be specifically stated why a student should know the prescribed material.

Because the manual arts program contributed to all segments of the junior high program, coordination of objectives was essential. Educational leaders realized this and thus manual arts' position was strengthened. The educational principles to be coordinated most closely with manual arts concepts were vocational interest, civic education and ethical character building.[27] Shop activities directed more and more effort toward exploratory and general developmental objectives. A study of the age group to be served stimulated change in manual arts. This change was away from the old formal type of woodworking with its joinery exercises and rigid procedure. The student's way of learning and acting were considered and influenced the program.

After the establishment of the first junior high schools in 1910, manual arts moved into an educational realm nurturing its concepts. However, to maintain and improve its status, a gradual alignment with junior high objectives was necessary. As the junior high matured, manual arts was forced to accept modification or to be eliminated from the movement.

Industrial arts as part of junior high industrial education was to go beyond simply "neuromuscular coordinations such as those involved in sewing, cooking, woodworking, clay work, or any other form of 'manual training'"[28] To avoid a shallow industrial orientation the school system was to offer the skills needed in the learning of industrial intelligence, industrial insight and industrial appreciation along with muscular control and coordination. Refinement and speed would be taught in a trade or vocational school rather than as a part of the junior high program. This concept of presenting industry at this level was in contrast to prevocational manual training and manual arts of 1911.

Later in the decade parallels between manual training and industrial arts were drawn. Pure motor training or motor training for a specific trade or industry left a lot of industrial education untouched. If manual training's objective was "the use of projects and manual activities as a means of developing appreciative insight and intelligence in industrial processes, problems, and conditions,"[29] then manual training and industrial arts were similar in nature and objective. However, their similarities were not used in many programs.

In the early 1920's a study was conducted to describe the position of industrial arts and prevocational education regarding objective, content and method. Over 300 junior high schools offered industrial or prevocational education to contribute "to the general experience, overall development and industrial intelligence" of their students.[30]

By the mid-1920's advocates of junior high industrial arts were able to claim that:

In no other place in the entire program of public education has industrial arts work received such unreserved acceptance and general recognition as in the junior high school.[31]

It was obvious to educational thinkers that industrial arts contributed to some of the most popular reasons for introducing the junior high. These included: Retention in school, recognition of the individual and exploration of aptitudes, interests and abilities leading toward an occupation.[32]

In addition James Glass presented results of a curricular study of junior high schools. Of the schools responding to his national inquiry, most junior high schools required industrial arts in the 7th, 8th or 9th grade. Less than 15 percent of the schools did not offer industrial arts as either an elective or a required class. By 1924 there was no question about whether or not industrial arts was in the junior high school along with math, English, physical education, science and social studies.[33]

At the junior high level industrial arts was usually for boys. The work was guided by four general objectives. These included:

(a) To satisfy the constructive desires of the adolescent by supplying a variety of shop experiences.
(b) To reveal the opportunities and possibilities offered in industry.
(c) To provide examination and study of vocations with their relative characteristics, advantages and disadvantages.
(d) To awaken and promote interests, to acquire and apply knowledge, and to develop abilities and skills of practiced use in the life with which the boy is now concerned.[34]

The concepts stimulating the early junior high school movement were also closely linked to the first general shops in industrial arts. "It seems clear that originally the general shop was little more than the industrial-education phase of the junior high school movement."[35] However, the concept of exploration as it was applied in the general shop helped to insure the continuance of industrial arts in the junior high.

There was to be a provision for "a sufficient number and variety of representative industrial activities to try out, discover, and develop any ability for understanding, doing, and managing industrial work."[36] To accomplish these goals it was proposed that a general shop organization be utilized. This shop program had the advantage of "having a great variety of materials, tools, and machines available in one room for immediate use."[37] Even though all the equipment, materials and techniques were chosen from different important industries, the program was not intended to produce a variety of skilled workers. Teachers chose from printing/publishing, forging, cabinetmaking and patternmaking and work involving foundry, sheet metal, carpentry, machine shop, concrete construction and general repair to be representative of industry in their industrial arts programs. With such a variety of industry housed in one location, students gained experiences in a variety of industries. This approach enhanced the exploratory purpose of the junior high schools.

As late as 1924 the general shop was still in its experimental stage. Where the unit shop was within the realm of possibility, the existence of a general shop was questioned. The primary factors of a successful general shop were to meet local conditions and to get teachers with certain personal elements. "The prevailing impression of work in the general shop is one of confusion, disorder, and waste of material and equipment and of time and energy on the part of both pupils and teachers."[38] The conditions needed for success were implied to be difficult to obtain in the junior high of 1924. Small classes or two teachers per class were declared essential for success. These conditions were thought to be accessible only in small schools. It was not until the innovative era of the 1960's that the general shop concept was adopted to significant sections of industrial arts.

As the general shop concept gained momentum, confusion became apparent. "The need for a commonly understood nomenclature among the industrial education people has never been more definitely felt than it is now in the discussion of the general shop."[39] The term "general shop" referred to physical facilities rather than to a course of study. However, in 1927 some educators disagreed with this definition.

In the late 1920's support was given to the general shop concept of industrial arts for the junior high. Warner[40] headed a committee presenting a display at the Ohio State Fair, 1929. In this display the general shop was given some new dimensions, and some old ideas were reinforced. The display was built around three concepts. First, exploration of industry was to be made possible when more than one industry became represented

in the course of study. The complexity of society warranted a broad exposure for the youth.

The second concept was avocational interests. It was believed avocational interests often pointed the way to a youth's career.

The third concept was consumer education, which was to help the student become economically wise in his purchase and use of industrially produced items.

QUALITY AND DEFINITION (1929-1941)

By 1929 the junior high was established in all states of the union. Some form of the multifaceted movement had adapted to the educational requirements and goals in a variety of situations. The number of students had increased from 119,921 in 1918 to 736,464 in 1926, and the number of teachers rose from 4,242 to 25,430 during the same period.[41]

In the 1930's educators assessed the effectiveness of the junior high school, and they were able to further define the purpose, function and status of the movement. An early form of evaluation asked, "Is the junior high school functioning?"[42] Four fundamental aims were acknowledged, and a followup of students was used to compare results to goals. The results of comparing aims with achievements revealed the status of the junior high movement.

Many researchers measured segments of the junior high program. They attempted to shed light on the success or failure of portions of the junior high. Leaders in the field conceded that the new system had some success. "Many opinions have been expressed regarding this new organization, but the question cannot be convincingly answered until more exact measurements than have been attempted are made."[43]

From the turn of the century to 1929 handwork in the grades between elementary and high school had changed considerably. Manual training, sloyd and manual arts merged and developed into industrial arts.[44] As the survivor, industrial arts was entrenched into segments of public education. One of its strongholds was the junior high of 1929.[45] Even though industrial arts was established, considerable effort was needed to clearly define it while striving towards quality.

On December 7, 1929, the first report was given by the Committee on Standards of Attainment in Industrial-Arts Teaching of the American Vocational Association. The committee was not given a specific assignment. It was to define and solve a situation which few were able to grasp. After careful consideration, the problem was limited to one segment of industrial arts. The committee "decided to limit the work to... a study of those things which the boy should know and be able to do, in the field of industrial arts, by the close of the junior high school period."[46]

The first report stated operations to be performed and understood by a boy leaving the junior high. Suggested areas for study were: Woodwork, household mechanics, electrical construction, sheet-metal work, printing and automechanics. The efforts of the committee were well received and appreciated.

The Committee on Standards of Attainment in Industrial Arts Teaching initiated an effort to further the quality of industrial arts in the junior high. In addition this committee further defined the goals of industrial arts. Before the final 1934 report was issued a variety of topics had been clarified.[47]

A second important step toward improving the quality of and defining industrial arts was the Terminological Investigation initiated in 1929 by the Western Arts Association. During the manual training section meeting, it was suggested that the term "manual training" was not an adequate title for this area of study. A committee was established to study other terms. The committee was concerned that "it is just as possible to pool ignorance as it is to pool intelligence via the avenue of the frequency study."[48] Eventually a scientific approach was developed.

By the late 1930's and early 1940's the work of Warner, Selvidge, the Terminological Investigation and the American Vocational Association Committee on the Standards of Attainment was accepted.

ACTION AND REACTION (1941-1957)

The writings of the mid-1940's indicated that junior high schools were an educational fact of life. Educators were concerned about how the junior high would progress, rather than if it would have a future. The status of the junior high was reflected in a National

Association of Secondary School Principals' meeting. The question was asked, "What is happening to the junior high school since we don't read so much about it any more?" The reply was, "The junior high school has come to be an established part of the educational system.... There is no need for campaigns to educate the people with respect to the junior high school."[49] The basic guiding concepts of the 1930's had been reinforced and established as guidelines for the 1940's and early 1950's.

Educators believed that total conformity was not necessary and that no one pattern for a good junior high school would fit all locations and community needs. To establish a basic functional program, certain standards were needed. The school staff were to be professionals. Working as a team was one expression of being professional. Closely linked to this was the concept that students, teachers and administrators were to be happy in their work.[50]

Industrial arts became aligned with the objectives and principles of general education in the junior high. Specifically, industrial arts attempted to meet individual needs and help students adjust to adult life. Trends were toward a broadened program of activities, the general shop organization, increasing enrollments, increased qualifications for teachers, improved physical facilities and a growing awareness of including girls in the program.

By May 1941 it was obvious that industrial arts was going to be called upon to assist in the war effort. The primary objective of industrial arts was to provide an adequate foundation from which defense workers could build needed skills for defense industries.[51]

On the whole teachers and leaders maintained the basic educational objectives structured for industrial arts programs. With or without the influence of war, industrial arts objectives were subject to change. The immediate problem was the war effort. However, it was believed that the Standards of Attainment in Industrial Arts Teaching as set forth by the committee still applied in 1944. The primary changes came from the belief that times and circumstances often forced reinterpretation of objectives.[52]

Before the end of hostilities, suggestions for industrial arts in the future were offered. The first consideration was in the area of industrial arts and skills. It was proposed that "there must be more emphasis upon skill, both in manual and machine processes taught."[53] Some extremists in the progressive movement had discounted the value of skill in industrial arts and prevocational education programs. "Where little or no emphasis is placed upon accurate, skillful performance of tool and machine processes, some of the most important educative values of industrial arts are lost."[54]

More emphasis was needed in the area of industrial arts and science. This implied teachers needed to adopt the objective of constant study of industry and science. It was further believed industrial arts should keep pace with industrial progress. The growing complexities of industrial processes and of economic and vocational life made it important that students developed "the habit of analytical constructive thinking."[55]

A greater emphasis on junior high industrial arts was suggested and was to appear partly in the form of enlarged time blocks and to be made more accessible to more students. Industrial arts educators were to be concerned with the objectives of industrial arts. The time was right to elevate industrial arts to a new position in the educational system.

Objectives for industrial arts were to reflect industry and society. In addition these objectives were to indicate behavioral changes similar to those in the objectives presented by Wilber.[56] It was considered essential to make each objective reflect the desired behavioral changes. This restatement of the objectives was also a check on their practicality. It was claimed that "unless the objective can be defined in terms of desired behavior, there is little likelihood that teaching for the objectives can be effective."[57]

To proceed one step further, it was recommended that learning activities designed to bring about change be listed. Each stated behavioral change was to include suggested learning activities; learning activities were also expected to suggest class organization with respect to individual effort, group effort and student responsibilities in the laboratory organization. The trend of Wilber's thoughts on objectives must be considered as part of the foundation that was later to support innovative industrial arts programs with their expresse goals of behavioral change and measurement of learning achieved.

The objectives of industrial arts were to be in harmony with the principle of general education. "Industrial arts simply help achieve the goals of general education by more specific means, making use of the subject matter it represents."[58] Through various industrial arts programs and activities, the students were expected to become better

members of society. The informal atmosphere of the industrial arts lab encouraged students to interact with each other and to develop concepts necessary to function in their industrial atmosphere.

ERA OF INNOVATION (1957-1976)

In the fall of 1957 the American public, and eventually American education, was questioned and criticized. The cause was Sputnik, a small device orbiting the globe and constantly reminding Americans that America was second to Russia in space achievements. Richards suggested that it was "doubtful if any scientific achievement of a foreign power has so completely shaken the citizenry of American as has Russia's successful launching of her satellite."[59]

Once the initial shock was absorbed, John Q. Public wanted to know why America was second best. Every possible reason was considered, even the educational system.

Eventually public attention focused on the American educational system. "Articles and editorials appearing daily in national magazines and newspapers across the country are analyzing, evaluating, and comparing our educational system with that of Russia."[60] Proposals for educational reform were made by people, not all of whom were qualified to give valid suggestions.

In the late 1950's elementary schools were under concerted attack and then it was "the senior high school under fire."[61] In the opinion of some educators, the junior high was to be next.

James Conant studied certain education problems. He was interested in the educational programs in which 12 to 15 year olds were involved. He gathered findings into A Memorandum to School Boards: Recommendations for Education in the Junior High School Years.

A lot of diversity was found in school systems when dealing with the placement of grades 7-8. "These grades are often found as the first years of a separate three-year junior high school in a 6-3-3 system; again, as the last two years of an eight-year elementary school in an 8-4 system."[62] Other systems included a 6-2-4 plan which had the 7th and 8th as the only grades in a junior high. Some districts divided grades 7 and 8 into a 7-5 educational plan; while others put grades 7-10 in a block or grades 6-8 in a junior high. However, "by far the most common of the reorganized systems are the 6-3-3, usually found in medium-sized and large communities, and the 6-6, usually found in small and rural communities."[63] However, the placement of the 9th grade was reported as having received no general consensus among educators. Was it to be placed at the top of a three-year junior high program or the bottom of a four-year high school situation? School districts arriving at opposite conclusions were supported by sound rationale and their community.

It was conceded that junior high schools of the late 1950's and early 1960's were under pressure as the result of American development and the overall world situation. Pressure also grew "out of the continuing international tensions and the increasing competition of Communist technology."[64] These developments contributed to a variety of trends in the junior high situation.

First, the exploratory segments of general education in the junior high were challenged. Students were grouped according to apparent abilities and given programs of study fitting their level of ability. Under this early sorting process it was believed goals of general education for all students were suffering. Early sorting of the academically able often resulted in an increased program of science, math and foreign languages. The talented child often missed the advantages of home economics, industrial arts, music, art and other areas of creative learning.

Another trend was the sense of critical times causing a feeling that every moment of a lesson was to be utilized. In many instances assignments were intensified, and programs were made "'hard for the sake of being hard.'"[65] Homework increased at the junior high level as well as the elementary level.

A trend noted by the Association of Supervision and Curriculum Development was that the influence of the senior high schools was apparent in the increasing development of many junior high activities and programs. Competitive interschool sports activities were common. (At one time they were restricted to the senior high school.) In addition "certain social functions in the junior high school are affected by the kinds of activities characteristic of high school level."[66] This was seen in 9th grade proms, noon dances, in some cases, elaborate graduation ceremonies.

As the 1960's progressed more people asked questions about the value and success of the junior high. The pattern of the junior high closely paralleled that of the senior high in athletics, social events, class scheduling and departmentalization. Junior high schools were thought to be a junior of the high school and not an education situation specifically operated to meet the needs of early adolescents.

With this variety and intensity of questioning, the stage was set for an alternative to the junior high school. The middle school idea was not new to America in the 1960's. A school between elementary and secondary was in existence in 1884. In fact the junior high was an early form of the middle school. Interest in the middle school was rekindled by the controversies of the late 1950's and early 1960's.[67]

By early 1963 the middle school existed in nearly every state and was growing. The middle school was to continue the best features of both the elementary and secondary schools. The growing middle school was to bring the ideas of the theorists in line with the practice of the classroom teacher. There was a "basic dichotomy between the professional writings of educators and the actual practices in the junior high schools."[68]

Industrial arts was in the middle of junior high/middle school and post-Sputnik curricula. Educators in general and industrial arts teachers specifically were concerned about the repercussions caused by Sputnik. As the blame for the space lag was set educators were expected to shoulder their share and progress from that point. "If our educational program is even in a small part to blame then we must meet the challenge, alter our educational plan and regain leadership in the field of science."[69]

Maurice Richards carried this interest further when he stated, "If the price to preserve our freedom is technological development, scientific skill, and industrial know-how, then science and mathematics must be the warp of our education fabric."[70] Either math or science was to be required all the way through public school and into the second year of college. Furthermore "all other studies should support the program as they now support English, reading, writing, and speech."[71]

At least portions of these suggestions were compatible with junior high industrial arts. Junior high industrial arts was suggested as being a primary factor in helping students gain a realistic perspective of material taught in other areas.

> Many teachers find, for example, that in the traditional type of education the child may learn to change feet into yards, yards into inches, and the like; however, upon being asked to make a practical application, the child has little notion as to whether a foot is longer than a yard or an inch is longer than a foot.

The child had learned a great deal of symbol manipulation but practical application had not been introduced.

Innovative industrial arts is best illustrated by the unique efforts of junior high/middle school teachers and leaders in the field who saw the tremendous opportunities at this level. It proved relatively easy to formulate and initiate industrial arts programs for the elementary and high school students. Students in these two levels can be described, measured and categorized by the rational person. However, the early adolescent is neither a child nor a young adult in physique, character or intellect. This age group represents the ultimate challenge for the creative and innovative educator. Perhaps these inbetweenagers have been best described by some as weird and feathery creatures whose most dominant feature is vacillation between childhood and adulthood. Nevertheless, students at this age level were ready for introduction to some of the most innovative industrial arts programs developed since 1929.

The variety of programs introduced with major segments in the junior high can best be illustrated by a listing. These included:

a. American Industry Project
b. Georgia Plan
c. Industriology Project
d. Orchestrated Systems Approach
e. Galaxy Plan for Career Preparation
f. Occupational, Vocational and Technical Program
g. Occupational Work Experience
h. Alberta Plan
i. Industrial Arts Curriculum Project

j. Industrial Arts: A Study of Industry and Technology (The Maryland Plan)
k. Industrial Arts Technology: A Study of American Industry (The Main State Plan)
l. The Parma (Ohio) Approach[73]

A strong bond among many of these efforts was that after over 30 years many of the basic concepts of the general shop had a place to bloom and become a part of industrial arts in practice as well as theory. A second important bond was that all of the above approaches depended upon the junior high/middle school for industrial exploration and attitude development as the student progressed in the educational system.

To fit industrial arts to the junior high student and his educational program, the primary function was providing industrial experiences of an exploratory and orientational nature. The experiences were to be characterized by a broad approach rather than depth in skill and understanding. It was understood "that these first experiences can and must supply a firm foundation for further, more advanced industrial arts offerings in the senior high school."[74] Besides having industrial orientation and guidance, industrial arts at this level was to have many factors in common with other junior high subjects.

In 1968 when many industrial arts leaders were giving more and more attention to the changes taking place in society, industry and education, A Guide to Improving Instruction in Industrial Arts was revised. The committee established to produce the document was "in an exponentially changing state, industrial arts education then by its very nature must be in a continual state of transition."[75] Many of the traditional goals of industrial arts were under attack in 1968, and many were considered valid. The addition of new concepts was constantly being suggested. The goals were presented not as a listing of all possible objectives, but as "a listing of the aims or goals that are relatively unique to the industrial arts curriculum."[76]

The specific direction for junior high industrial arts was to give students exploration experiences with broad exposure to the fundamentals of industry and technology stressed. The program was to include opportunities for youth to plan, to experiment and to work in major industrial arts areas. In order to set this into the context of objectives, it was suggested that specific objectives be stated for the junior high program.

In discussing the status of industrial arts in 1971, Suess noted the existence of two vocal groups. On one side "there are outcries of liberal thought which recommend that the profession set aside all facets of current practice and replace them with totally new programs."[77] On the opposite side, conservatives were "calling for retrenchment in tried-and-true practices which have been the central elements of industrial arts courses and programs."[78] Industrial arts education was carried on by the majority of teachers somewhere in between these two extremes.

By the late 1960's concepts of middle school industrial arts were becoming more evident. "With the announcement that the vast New York City system will drop the present 6-3-3 plan and adopt a 4-4-4 plan, a trend is definitely established."[79] This major alteration of the junior high school was expected to be a great disappointment to those educators who had dedicated so much to the junior high program.

The state of junior high middle school industrial arts in the early 1970's was one of unrest and unique contribution. Industrial arts educators wanted all facets of contemporary industrial arts abandoned and replaced with totally new programs. On the other hand there were teachers who wanted to return to the tried-and-true practices of years past.

Whatever form industrial arts had taken, it became firmly established at the junior high/middle school level. The rapid growth of industrial arts paralleled the growth and acceptance of the junior high/middle school. Industrial arts at this level was designed to help students evaluate their aptitudes, interests and potentials. Some programs overemphasized certain hand skills and provided only a narrow look into various industrial areas. Others developed into programs in which adolescents of the intermediate school could study the industry of America.

Many educators were concerned with the position industrial arts was to assume in the middle school structure. There was a deep concern that very few junior high schools had industrial arts programs and facilities distinguishable from high school patterns, therefore offering a poor pattern for the middle school. This situation was at the center of many conversations of industrial arts educators as they attempted to define industrial arts for the new middle school.

In the early 1970's industrial arts for the middle school was without adequate

direction. Many subject areas were working on their new roles for the middle school. Attempts ranged "from cooperative teaching by unification of allied subjects to merely moving the traditional programs down a grade or two."[80] Industrial arts along with many other special subject areas had not yet defined its role in the new middle school organization. In addition, in some of the first stages of building, industrial arts programs were not included.

The unique contribution of industrial arts in the intermediate school was the most vivid in 1909 to 1929 and 1957 to 1976. In these two eras industrial arts entered the educational system as a supporter of goals and a contributor of educational substance. The first junior high schools included industrial arts because industrial arts could fit the needs of students as they learned to live in a changing society. The era of the middle school also recognized the versatile value of the industrial arts programs as attempts were made to reintroduce the goals, if developed, for the education of inbetweenagers.

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Toward the Year 2000—Futuristics

James A. Hales, James Snyder and William R. Thompson

Our society is changing at an ever increasing rate. As technology plays more of a part in our lives, we see jobs, materials and processes, and even man change. To understand this phenomenon, and to live in harmony with it, our society must turn to its educational system for direction, preparation and hope.

We will discuss the following topics:

1. The philosophical base of industrial arts education
2. The need for up-dating the industrial arts curriculum to reflect the present and future trends in technology
3. The assessment processes for determining societal and technological needs in the future
4. The scope of a typical "futures" curriculum.

Except perhaps during his earliest stages, man was always a tool-using creature. At first, the tools and skills he employed were those needed for survival. Man learned principally by trial and error or imitation. As time passed, fathers usually taught their sons all of the skills needed to be a contributing member of the tribe. This practice continued for many years, as the tools used were simple and the skills primitive.

As different social structures emerged, different members of the clan developed specialized skills and tools in line with the unique contributions they could make. As these skills became more specialized, the old father-son learning system was no longer effective and the apprenticeship system emerged. In that system, a craftsman would take several apprentices into his care with the goal of teaching them not only the skills of the craft, but often more importantly, the moral, spiritual and cultural aspects of society. The apprenticeship system proved to be rather successful in providing fine craftsmen for many years, but with the coming of the Industrial Revolution, the system could not maintain either its high standards or the quantity required. Schools were the answer to the problem. First came the mechanics institutes and technical institutes. Educational programs such as manual training, practical arts and manual arts were introduced; others followed. These helped to provide the craftsmen and workers society demanded in order to keep pace with the growing technology of the time.

Today, we have two forms of education which deal with tools and their uses: Vocational education and industrial arts education. Vocational education evolved directly from the schools of the post-Industrial Revolution era. Though the emphasis is on technology, vocational programs employ unit shop concepts for the study. Specialized training is offered in one craft. Industrial arts education also places emphasis on modern technology, but does so in another way. Industrial arts programs employ multiple activities (general) laboratories to examine the entire technological spectrum. Their purpose is to provide opportunities for students to understand industry and technology, to experience some of the processes of that technology and to find their own place in society.

In comparing the stated objectives of the two forms of technological education (Figure 1), we find that each is based upon a curriculum which reflects the most modern state of technology and industry. If these programs did not keep up with technology, their product (the student) would fail, industry would fail and that kind of society would cease to exist.

Figure 1. OBJECTIVES

Vocational Education	Industrial Arts Education
1. Development of the latest skills of industry	1. Develop technological literacy to succeed in modern society
2. Preparation for present or future careers	2. Explore individual needs and abilities for role in society
3. Training for immediate and successful job entry	3. Develop awareness and insight into the role industry plays in society
4. Retraining of adults for new jobs	4. Introduce present and future career opportunities

In order to visualize what can happen to a society if education does not keep up with contemporary technology, let us examine a book by the fictitious author, J. Abner Peddiwell, entitled The Saber Tooth Curriculum.

According to the story, a man named "New-Fist-Hammer-Maker" lived in the paleolithic culture. He noticed one day that the children of the tribe had little or no direction in their play and therefore contributed nothing to the welfare of the group. He decided to teach all of them the technical skills needed for a successful existence both in that tribe and in the surrounding environment. After a careful assessment, he established three courses of instruction: Fish grabbing with the bare hands; woolly horse clubbing; and

sabertooth tiger scaring with fire. As the educational system matured and the children grew, it was plain to see that the tribe prospered greatly from the learning that had occurred. Advanced courses were then offered in the three areas and still greater tribal growth resulted. All was well with the tribe.

All good things must come to an end, however. As it happened, a new ice age approached that part of the world. As the great glaciers neared, the streams grew muddy, making fish grabbing next to impossible. The land surrounding the streams became cold and marshy, making it difficult for the woolly horses to maneuver. The result was that they moved to the dry lands of the east. With them moved the saber tooth tigers who were highly susceptible to the cold, damp climate and often got pneumonia. The techniques taught in New-Fist-Hammer-Maker's school were no longer applicable. No fish could be caught, no woolly horses could be clubbed and no tigers were around to be scared.

As hunger and fear spread throughout the tribe, individuals found other ways to survive. The fish in the now-muddy streams could not be caught with the bare hands, but could be netted. The antelope, which moved in after the woolly horses left, could not be clubbed, but could be snared. The ferocious glacial bears, who followed the glaciers, could not be scared with fire, but could be trapped in pits. So three distinct new skills evolved: Fish netting; antelope snaring; and bear-pit digging.

Now, one would assume that these new skills would be accepted immediately into the school curriculum. They weren't. The teachers felt the curriculum was good enough as it was, for it had allowed the society to prosper for so many years. The curriculum was too crowded, anyway. When challenged on the worth of fish grabbing, horse clubbing and tiger scaring when these skills no longer could be employed, their response had a very familiar ring. "Not only are these subjects time-tested, but children enjoy them, and it gives them a chance to relax from the rigors of other learning subjects. We don't teach these skills for their use; we teach them to provide a basic general foundat , to provide some insight into the history of tools and processes, to learn safety techniques and motor skills."

The saber-tooth curriculum went on teaching technical skills and processes which were out of date and totally worthless, save for weak justifications which could have been applied to the modern techniques as well. As you might expect, their society failed, due mainly to an educational system which did not keep up-to-date with the technology of the times.

Let us turn our attention to the modern school curriculum. In industrial arts, there are many programs which have merit, but most suffer from the same "ego-itis" that afflicted our paleolithic predecessors.

For those who teach unit shops, we have already noted that, due to its limited scope, your program is more aligned with vocational education than with industrial arts. For the sake of analysis, however, let's look at a wood shop, a metal shop and a general shop representative of a well known curriculum.

A typical course of study for a unit wood shop focuses special attention on the knowledges and skills associated with the cabinet-making trade. Analyze for yourself the relevance of such a course in view of the lack of fine cabinet woods for the production of good furniture. How long has it been since you've had mahogany, cherry, walnut and birch in any quantities in your shop? Would the justification for a continuation of these areas of learning be similar to those the paleolithic teachers used? I believe a greater emphasis should be placed on the use of pine, as it is in abundance and used in plywood, wood laminating, veneering, plastic impregnated woods, particle boards and plastics. Could these be added, or is the curriculum overcrowded already? What is the value of a grandfather's clock?

Let us consider a typic course of study for a metal shop. Here we would probably find a rather diverse assortment of skills and processes in a unit area, as opposed to the wood shop we have just discussed. If you were the teacher, however, how would you handle the suggestion that arc welding be minimized in lieu of the commercially available cements which bind metals as well as the welding process? Would you quickly defend metal machining though electrical and chemical means are equally viable processes for shaping this material? In relationship to modern technological processes, what is the value of art metal?

Next consider the content of construction in the Industrial Arts Curriculum Project. This program, for the most part, could have been offered at the turn of the century; it may have been an outstanding vocational program at that time, too. Today, with mass-

produced housing, modulars and styrofoam walls, I wonder if this curriculum really prepares youth for even the modern world of construction... which brings up two more questions: Is IACP really addressed to the objectives of industrial arts education? Does IACP prepare youth for modern technology and society?

We could go on analyzing and questioning most of the industrial arts programs now in existence, but that would be useless. The most important thing to realize is that most programs are dated. We have failed to look at what is happening around us and employ it in our teaching. We wallow in our pride and consider change unimportant, for what was good for so long will always be good.

Dr. Hales, Mr. Snyder and myself came here today with a warning. Technology and society are changing. They are moving so rapidly that we will surely be destroyed as individuals, and as a society, if we do not keep up with that change. It is estimated that 75 percent of all of the processes you will employ in ten years have not yet been invented. Industry, as we know it, will change so drastically by the year 2000 that we would not be employable with the abilities and knowledge we have today. Computers will take over our lives so completely that there will be no freedom of expression, movement or thought. All activities will be controlled and all pleasures limited.

There is, of course, a way of avoiding these disasters. It lies in two words: Awareness and planning.

It has been my aim to make you aware of the problems we face as industrial arts educators. I have attempted to establish the philosophy and objectives of our discipline, to cite the importance and need of updating our curriculum to reflect the present and future trends of technology and to warn of the impending peril of technology run rampant.

Dr. James Hales will discuss the topic of "Technology Assessment."

The future cannot be known and will certainly be different from what exists now, and perhaps from what we expect. The best we can do is to carefully anticipate the future through systematic planning techniques. The results can thus be translated into operational programs prior to societal needs, rather than after the fact.

One of the techniques developed over the past few years, but which may be relatively new to industrial arts planning process, is forecasting. Forecasting is usually described as a process of focusing on the consensus of opinion as to what will probably happen at some future point in time. It is based on the best available information or judgment of selected documents or people considered expert in the field of concern. Because the process is highly intuitive and judgmental rather than empirical, it is frequently discounted by researchers. It is, however, a most effective and valid process for future-oriented planning. The authors submit that only through forecasting techniques will we ever begin to approach the reality of curriculum planning in 1976 for effective implementation in 2000 A.D.

There are a variety of forecasting techniques available for the curriculum planner's purpose. Two of the most prominent include the Delphi technique and Cross-Impact Analysis. Comprehensive and in-depth planning will involve the use of both techniques, with the Delphi providing the data base for Cross-Impact Analysis.

The Delphi technique utilizes a series of questionnaires addressed to a future-oriented problem such as what type of technology education curriculum will be required in the future. The specific wording of such a question would, of course, be carefully chosen. The interrogation of, and feed-back to, a panel of experts would continue until a general consensus of opinion was reached. The selection of panel members, the wording of the questionnaire and the organization of data, each determine the effectiveness of the processes.

Using data obtained from the Delphi, the curriculum planner can then utilize Cross-Impact Analysis to determine the probability that the findings will occur. This method identifies the effect that any one item will have on each of the other items identified with the Delphi. This technique utilizes a matrix as the organizer of the collected data. In this process each predictor is considered as true.

The goal of intuitive forecasting techniques is to understand technological forecasting in the same way we do economic forecasting. The process provides useful information which, together with other descriptors, can provide a basis for future planning.

Another method of forecasting the future is "linear projection." The investigator first studies the events of the present, as they are related to the problem being considered. The rates of increase or decrease over the past few years are then estimated. Assuming

the trends will continue into the future, a projection is made for a number of years into the future. This technique does not take into account any unknowns or surprise developments.

A scenario or future history uses a narrative description of a potential course of development leading to a state of affairs. A detailed description of a possible future and the events leading to that future are multiplied several-fold to provide alternatives to the typical single set of concerns.

Most professionals find it difficult, unpleasant and usually impossible to think about highly undesirable events. This is particularly true when it becomes a threat to their own livelihood.

The future comprises an intricate series of interacting events, many of which are simply unpredictable. The broad involvement of expertise, the force of interaction, and the opportunity for creative and imaginative thinking all improve the chance for accuracy, however. Thus, while forecasting takes its place as the best initial step to long-range planning, it should not serve as the final piece of research.

In terms of curriculum structure for the future, industrial arts objectives should be reviewed. They include developing technological literacy to succeed in modern society; exploring individual needs and abilities for role in society; developing awareness and insight into the role industry plays in society; and introducting present and future career opportunities. These are worth keeping in mind as we explore the curriculum of the future.

An extensive research of the present curriculum seems to reflect a premise that the majority of technology education is very conservative, wades in tradition and does not address itself to any future societal expectation. Curriculum research also indicates a predominance of the unit approach and very little attention to interdisciplinary involvement. If technology is a total societal factor, and if man is to be a part of that real societal framework, then there must be a fusing of the total curriculum to relate man/society/technology.

Today's curriculum in industrial arts is not really technology/society-oriented. Industrial arts curriculum is still dealing with materials in a mono-environment, paying little or no attention to the future application of techniques required to blend with other than the terrestrial environment. Present technology education (industrial arts) laboratories also reflect this traditional curriculum. Accommodating an environment-related curriculum approach will require a new, futuristic design. This design must reflect a curriculum based upon an environmental approach. To date we have merely accomplished an expansion of industrial arts in a horizontal direction without getting at a vertical (depth) direction. We as educators have gone into construction merely from the terrestrial environment and not explored the others. Construction is used here only as an example and not to be spotlighted in isolation. We have yet to expand curriculum from the "this" to the "that." <u>This</u> is, <u>that</u> will be! If we listen to the forecasts and analyze what they are saying, then we had better get on our way and design a new curriculum strategy.

The new curriculum may well dictate that in order to accomplish its goal, teaching environments may also have to change. The curriculum may require a "weightless environment," an "aqua environment," or an "artificial terrestrial environment" to simulate the "real" world situation. This would be addressed to man and his technological society.

For our purpose, let's examine a possible structure that has been designed around a systematic approach entitled a <u>Vehicle of Study</u>. Such a model would combine various environments to create curriculum studies. For example, terrestrial, space, atmospheric and aqua environments. A second level of study would involve each in production, transportation, communications and "human cultural networks technology." Each of these in turn would be reduced to smaller units of study. When the model is examined closely, a total of 64 study combinations are possible. Addressing these combinations, one would soon realize a need for facility changes.

The future cannot be "known." However, it will certainly be different from what exists now and perhaps from what we expect. The best we can do is to anticipate the future with a systematic approach. A curriculum designed on this basis should be projected toward the future of man and address such "Star Trek" ideas as asteriodal living; aqua cities; space manufacturing; and altered states of transportation.

Man must be prepared, aware and able to plan his future. The study of technology

can equip our future generations to cope with and control their technological society.

The "Vehicle of Study" model is designed to be contemporary for years to come. The only change would be the current components for the categories. How we extract from the system may change, but extraction will continue.

In the final analysis, our concern does not rest with the present but with the future. The technology is available to meet tomorrow's curriculum, if human conditions will permit.

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The Ideology of Industrial Education, 1876-1917: A Social and Historical Analysis

Dennis R. Herschbach

In 1876 industrial education was little more than an idea, often vague, largely devoid of concrete form or organized support and without the test of successful implementation. By 1917, this idea had firmly challenged the traditional concept of classical education. A recognized professional leadership with a loyal cadre had been developed, and teacher training programs were established in a number of institutions. The first federal bill to support public education below the college level was passed in the form of the Smith-Hughes Act to aid vocational education. This was no small political feat, in view of the strenuous opposition to federal support for any form of public schooling below the college level. On the eve of the passage of the act, moreover, an amazing 75 percent of American high schools included industrial education programs among their course offerings.[1] Few subject fields had taken so firm, so sudden and so permanent a hold on the school curriculum as did industrial education.

The successful introduction of industrial education into the public school was as much as anything a triumph of ideas. That body of ideas — that ideology — had emerged out of an intellectual debate of four decades. That ideology was used to thrust the subject field into the mainstream of American social and educational thinking.

Although we do not generally recognize it, much of educational rhetoric is ideological. That us, ideas and arguments are publicly expressed for the purpose of influencing the actions of others. This is vital to the life of any social group. It is through common ideas that action is stimulated, group cohesion is attained, and public acceptance and accountability are promoted. In the case of industrial educators, they were immensely successful in gaining support.

What were the arguments advanced by supporters of industrial education? To which social and educational groups did these individuals address themselves? I would like to focus briefly upon these extremely important questions. The early ideas concerning the importance and place of industrial education in American schools contributed toward the development of a theoretical stucture to undergird the subject field. These ideas constitute a philosophical, psychological and socio-economic rationale for the subject field. To a remarkable degree, this rationale is relevant today.

These early ideas also relate to a question that has been persistently debated: What are the differences between industrial arts and vocational education? Like educators today, the early supporters of industrial education were highly interested in defining the different roles the subject field could play in public education.

Finally, these questions are important because they provide an understanding of the interaction between thought and social setting. Ideas in themselves take form as correlatives of distinct social conditions. It is only when the social forces that impinge upon the formation of ideas are objectified and brought to the level of consciousness that ideas take on their full meaning.

THE STIMULUS TO CHANGE

It was during the score of years on either side of the turn of the century that American education underwent the transformation which resulted in the basic structure of our modern educational system. The stimulus to this transformation was the social change sweeping the country. In the later third of the 19th century, industrialism and urbanization rapidly spread across the country. Whereas in 1870 the economy was basically agrarian, by 1917 the country enjoyed industrial supremacy. While in 1860, 5 million people lived in cities, by 1900, 25 million resided in urban areas. Immigrants poured into the seaport cities of the promised land. Rural residents, lured by the glamorous life of the city and the possibility of jobs, flocked to the large population centers and were probably the most important source of urban expansion. Larger numbers of children crowded the schoolrooms each year. In 1900, there were over 200,000 youths in public high schools, a decade later over 500,000 and by 1910 over 900,000. In the same year there were over 16 million children in public elementary schools.[2] Educators were forced to reconsider both the aims and practices of schooling in a nation which was experiencing a fundamental economic as well as social and educational transformation.

THE MASSIVE INFLUX OF STUDENTS

One factor that brought about the introduction of industrial education into the public school was simply the massive increase of students. Greater numbers of children, more often than not the sons and daughters of working men, immigrants and the rural and urban poor, entered the school house each year. These children lacked the background, desire, or money to remain in school for long. For many students there was little hope of progressing successfully through the educational system. The school was as alien to them as their ways were to the school.

There was now simply a different class of students in attendance — a class to which educators were unaccustomed. Had there been no Douglas Commssion in 1906 to investigate the need for industrial education in Massachusetts, or no National Society for the Promotion of Industrial Education, or if Calvin Woodward had stayed with his study of mathematics, or if John Dewey had not left his father's store in Vermont, schooling would still have undergone considerable alteration and become less idealistic and more realistic and practical in nature.

Industrial education supporters capitalized on this growth in enrollment. If public schooling was going to meet the challenge of this massive influx of students, it was argued, then it had to offer studies that could be of profit to the child of the working man. "Boys will stay longer in school than they do now," affirmed Calvin Woodward of the St. Louis Manual Training School. Felix Adler of the Workingman's School told the National Conference on Charities and Correction in 1888 that "precisely those pupils who take the least interest or show the least aptitude for literary study are often the most proficient in the workshop and the modeling-room."[3] Similarly, the basic theme of the influential report of Susan Kingsbury to the Douglas Commission in 1905 was that the villain behind child labor and early school-leaving was the school itself. It did not offer "continuous schooling of a practical character" for the five-sixths of the student population who were leaving school before completing the seventh or eighth grades. If an industrial education were provided, Kingsbury strongly argued, not only could those leaving school early be retained, but these youth could obtain the skills necessary for occupational success.[4]

America had entered the age of mass education. Differences in program design or educational philosophy were largely over-shadowed by the necessity of absorbing large numbers of working class children into the mainstream of American education. This fact, more than any other, probably accounts for the successful introduction of industrial education into public schooling.

THE IDEOLOGY OF SOCIAL REFORM

The earliest advocates of industrial education were not educators, but social reformers. The cities were the generating centers of the nation's newly found industrial wealth, but they were also the source of unprecedented misery, crime, violence and poverty. The rapid industrial-urban change threatened social cohesion. An impersonal, dynamic city-life broke down the more stabilizing traditional values of home and community. Again, the rural American, migrating to the industrial center, was just as much uprooted as the newly arrived immigrant; both were bewildered in a strange environment. Then too, the sprawling, festering slum ghettos fostered discontent, and the scores of poverty- and strife-ridden made the growing social and economic cleavage between different social, ethnic and racial groups only more evident.[5] Reform groups were the first to experiment with industrial education programs for youths as they attempted to provide the institutional and social services necessary to alleviate many of the hardships experienced by slum children.

Throughout the 1870's, and particularly in the latter half of the decade, private promoters of the kindergarten built a strong case for industrial activities as an integral part of programs designed to uplift the poor and neglected. In the case of older children, industrial schools, like the Workingman's School of New York City, founded in 1879 by Felix Adler, strongly emphasized mechanical and domestic arts instruction. Soon, success in these ventures led to an attempt to introduce industrial education into the lower grades of public schools. The introduction of Sloyd instruction and arts and crafts was a direct result of such efforts by social reformers.[6]

These charitable and religious agencies — city missions, mother's clubs, private industrial schools, aid societies — outside of the public school system, cultivated a positive public opinion regarding industrial instruction and joined public schoolmen in setting into motion a vigorous drive for common school industrial education.

From the pedagogical point of view, industrial education was supported because it was thought to balance a curriculum which was regarded as being too heavily weighted with "booklearning" and as unsuited to less academically inclined youths. Then too, industrial education hopefully could be correlated and integrated with other subjects of the curriculum, resulting in a richer and fuller educational experience. From the social point of view, industrial education was advocated as a means of providing an educational environment in which work habits as well as cooperation in work and play could be developed. Furthermore, industrial education was expected to supply the educational setting in which students could gain an understanding of the industrial environment in which they lived. Considered no less valuable was the fact that industrial education could develop character and habits which could lead to success in an industrial world as well as provide the student with the educational enrichment thought necessary for appreciating and participating in the cultural heritage of society.[7]

One result of the close connection of social reform with the industrial education movement was the placing of certain industrial education programs, like industrial arts, within the school of educational thought known as social reconstruction. The ideas of social reconstructionism before the turn of the century are best represented in the early kindergarten, the work of Francis Parker, Sloyd, arts and crafts instruction and early private industrial schools founded by reformers. After 1900 these ideas were best represented in social settlement schemes and community-centered programs of schooling, as illustrated in the work of Jane Addams, Florence Kelly, John Dewey and Samuel Dutton, among others.[8]

John Dewey was perhaps the most articulate spokesman for the social reconstructionist view point. Dewey argued that in an industrial society, the school had to become more industrial. His central point was "that education could prepare the young for future social life only when the school itself was a cooperative society on a small scale." Thus, in general, Dewey would have students learn what industrial society could be through reliving its problems and manipulating its materials, techniques and knowledge. Industrial education could impart an understanding of industrial society and the necessity of social cooperation, discipline, mutual understanding and democratic processes and ends. Only in this way, he felt, could education ensure that the tremendous scientific-technological forces sweeping the country were, indeed, utilized to promote humanistic and democratic ends.[9]

It was from the ideology of social reform that the "Industrial Social Theory" of

industrial arts, promoted by James Russell, Frederick Gordon Bonser and others, evolved.

THE PSYCHOLOGY OF REFORM

John Dewey was also primarily responsible for the development of an interactionist-developmental psychology which, in turn, lent considerable legitimacy to the claims of industrial arts supporters. Dewey placed primary emphasis upon individual growth rather than mastery of subject matter. Drawing from Froebelian thought, Dewey considered learning to result from the reorganization of the child's intellectual and psychological structure through his interaction with the environment. This process was considered to be developmental; the child's development progressed through sequential stages, but neither were these stages directly related to biological maturation nor did they constitute direct learning. Instead, the attainment of a higher level or stage was dependent upon an educational environment that stimulated development through an active interplay with that environment.[10]

The effectiveness of industrial education activities in stimulating the child through problem-solving situations and cognitive activity was valued by Dewey. Industrial activities provided a medium for the activation of learning. They were interesting, held the attention of the child, and provided a means of stimulating the imagination and thinking, as well as exposing the child to the materials and processes in his immediate surroundings. Finally, industrial activities provided a variety of subject matter necessary for the correlation of a broad range of knowledge and facts. It was from the interactionist-developmental theory of Dewey and others that Bonser structured his industrial arts program at Speyer School.[11]

While it is certainly true that over the past years variation has characterized much of the program development within industrial arts, the fact remains that an interactionist-developmental psychology has been a major influence in industrial arts program design. Moreover, the work of contemporary theorists like Jean Piaget, David Ausubel and L. S. Vygotsky, among others, has provided a means of strengthening and broadening the psychological base of the subject field.

The interactionist-developmental psychology of Dewey grew out of the same social reform impulse behind the early industrial education movement. Dewey borrowed heavily from Foebelian psychology, which also undergirded the early kindergarten, the industrial school of Felix Adler, Sloyd and the arts and crafts movement. The pioneering work of the reformer and early progressive Francis Parker during the 1889's and 1890's inspired Dewey. While Parker wanted to make schooling more child centered, Dewey wanted to make it more socially centered and still retain Parker's humanitarian emphasis. Dewey may have differed from early Froebelians and Francis Parker, but these differences did not alienate him from the social reform movement. Instead, they placed him at its head. Dewey gave educational reform a social purpose which placed it in the mainstream of pedagogical thinking around the turn of the century.[12]

Thus, while industrial arts is united with the early social reform movement by an industrial social theory, it is also joined by an interactionist-developmental psychology. The ideology of early industrial arts, in other words, links the child-centered curriculum of Francis Parker with the socially-centered school of John Dewey, the social moralism of Felix Adler with the social reconstruction of Jane Addams, and the textile work of the arts and crafts movement with the study of the industry of textiles in the Speyer School, Columbia University.

THE IDEOLOGY OF SOCIAL EFFICIENCY

Other early sources of support for industrial education were businessmen and commercial and industrial groups. One of the earliest and most persistent arguments for industrial education was that it was needed for the economic development of the country. Indeed, industrial education emerged as a subject field of public education in response to the rapid industrial transformation of the nation. Industrial-urban change not only affected the work skills and tasks of the workman, but also resulted in a redefinition of the meaning of work. The old apprenticeship system had apparently ceased to function adequately in a machine production age, and organizational, managerial and scientific skills became more important. At the same time, a differentiated work force emerged which dovetailed with the differentiated tasks of the industrial enterprise, and large numbers of unskilled and semiskilled workmen were needed to perform the duties of production.[13]

It is not surprising that the activity of businessmen in support of industrial education became accelerated. The backing that made it possible to establish the Manual Training School of St. Louis, for example, was provided by leading businessmen with whom Calvin Woodward worked closely. The Manual Training School of Chicago was founded by the Commercial Club of Chicago, a group of 60 merchants and manufacturers, and the first public "free" manual training school, established in Baltimore, Md., in 1884, came into being through the efforts of a group of businessmen. In Boston, programs of industrial education on the primary, secondary and college levels were the direct result of the active support of the Committee on Industrial Education, a group of interested civic and business leaders. In numerous other cities and towns, commercial clubs or groups of businessmen provided both leadership and financial backing to industrial education associations and other similar groups that promoted tax-supported industrial education programs in the public schools. Privately endowed technical institutes and trade schools also proliferated and had no less a decisive impact on the promotion of "practical and useful education."[14]

After the turn of the century, business interests lent their support to the drive which resulted in the passage of the Smith-Hughes Act of 1917. The Douglas Commission and the National Society for the Promotion of Industrial Education, among others, successfully generated action for government support, and thus secured a permanent place in American education for vocational education. But these groups were successful mainly because they clearly articulated an ideological position which stressed the economic importance of industrial education. The subject field could, its advocates contended, feed the growing industrial needs for trained manpower: New technological skills could be taught, creating a skilled manpower pool; industrial intelligence could be developed, thus insuring the worker a greater economic gain; labor could be dignified and ennobled; the antagonism between manual labor and intellectual training could be reduced; and work values could be stressed, thus adapting immigrants and rural migrants to the urban-industrial environment. The means of achieving these aims was to differentiate students early in their school career, provide training in specific job skills and inculcate in these students proper attitudes and habits toward work. These views came together in the educational philosophy of social efficiency supported by Charles Prosser, David Snedden, Charles Allen, Ellwood Cubberly, Edward Thorndike and Frederick Taylor, among others.[15]

Vocational industrial education, then, was clearly based upon a foundation of social efficiency. Industrial and social efficiency was thought to have been achieved through the introduction of industrial education into the public schools, and its supporters saw the subject as a means of creating individuals who were useful to society both vocationally and in terms of social responsibility.

THE PSYCHOLOGY OF EFFICIENCY

While John Dewey was providing a psychological concept which supported the development of industrial arts, Edward L. Thorndike was developing a behavioristic psychology which supported vocational education. Unlike Dewey, Thorndike placed primary emphasis upon the mastery of subject matter.

Thorndike showed through his experiments around the turn of the century that very little general learning actually took place, and that transfer of training did not result from such learning as was previously assumed. Ability developed in one set of studies did not appear to transfer, except in cases where there were identical elements. The study of Latin or woodworking did not appreciably help the future doctor, accountant or plumber in developing any general mental ability, and thus was important only to the extent that it was utilized by the individual in a specific way. The emphasis in education shifted from training all students in general subject areas to training students for specific ends. The way was opened for the development of a differentiated school curriculum.[16]

Thorndike provided vocational education supporters with a powerful psychological argument to reinforce their demands for specific occupational training. Moreover, the concern of Thorndike and other behaviorists with stimulus-response bonds and terminal behavior led to the practice of breaking subject content up into small, identifiable elements. Vocational educators, like Charles Allen and Robert Selvidge, readily adopted this practice and developed the trade and job analysis approach to course construction in vocational education which has enjoyed immense popularity.

By the time of the passage of the Smith-Hughes Act of 1917, the ideas of early trade training proponents like George Alden and Richard Auchmuty had been absorbed into the social efficiency concepts of David Snedden and Charles Prosser. Then too, the psychological rationale for vocational education advanced by Edward L. Thorndike supported the efficient administrative practices of Ellwood Chubberly: Students would be differentiated early in life and would be processed in an efficient and rational educational system through the instrumentality of trade training. The result, hopefully, would be a well trained worker who could help in manning the machines of production while at the same time sharing in the material prosperity he had helped create.

CONCLUDING REMARKS

If industrial education captured the attention of the educational public by 1917, it was in no small part due to a strong appeal directed at a generally receptive public awakening to the full realization of the impact of the social and industrial changes then sweeping across the country. In other words, industrial education supporters succeeded in clearly articulating an ideology — a set of ideas regarding the function and purpose of industrial education in the public schools. Through a well articulated ideology, industrial educators gave purpose to the movement and form to its programs.

By the passage of the Smith-Hughes Act, the industrial education movement had become polarized. Those who represented what is called industrial arts traced their lineage back to one set of ideas, and the advocates of vocational industrial industrial education traced their lineage back to another. This fact is important, for it identifies the ideological antecedents of our contemporary programs of industrial arts and vocational industrial education. Industrial arts is undergirded by an interactionist-developmental psychology which in turn clearly sets it off from the behaviorist psychology which supports vocational education. Consequently, markedly different program design and aims characterize industrial arts and vocational education. Each subject field is also characterized by an appropriate social philosophy: One is the ideology of social reform; the other is of social efficiency.

We have 100 years of pedagogical development behind us, and we stand at the crossroads of the next 100 years. What will industrial arts represent? What role will it play in American education? As we ponder these questions, perhaps it is appropriate that we turn back and examine our past in greater detail. The key to the future role of industrial arts may well lie in our past — what role we have played in American education and why. If we have a clear understanding of what we have represented, perhaps we will be able to determine with greater assurance what we shall be in the future.

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The Works and Influences of William E. Warner

Thomas G. Latimer

The works and influence of William E. Warner can better be appreciated by looking first to the early history of industrial arts. Manual training, influenced by the Russian method of technical training and the Scandinavian handicraft system known as Sloyd, was introduced in the U.S. around 1876. Near the end of the 19th century the emphasis on formal training and exercises was modified. The result was manual arts. As early as 1904 Charles Richards proposed what he called industrial art. In industrial art, emphasis was to be placed on "elements of industry." Very little was done with the idea of industrial art, later to be called industrial arts, until Frederick Bonser proposed an elementary school industrial arts curriculum centered around changes in materials to reflect those carried on in industry.

Limited progress was made in gaining acceptance of the concept of industrial arts for several years. This was due to various factors: This was a period of conflict for education in general. Dewey's child-centered, social theories of education were in conflict with the traditional subject-centered curriculum, including that of industrial arts. Bonser proposed to implement Dewey's theory in an industrial society.

For the most part, however, industrial arts teachers were not interested in such a proposal. Their training had centered on skill or technical training, and they were not concerned about the psychological, sociological and philosophical concepts which Bonser emphasized in his industrial arts curriculum.

The Dewey-Bonser concept of industrial arts as general education conflicted specifically with the status quo of several programs: manual training, manual arts to a degree, vocational education, and most programs that were called industrial arts. One aspect of this controversy centered upon the use of unit shops rather than general shops to teach industrial arts.

Many times the terms "manual training," "manual arts," "vocational education" and "industrial arts" were used almost interchangeably. Confusion existed about what these terms meant, and there was little difference in the programs taught under these titles. The purposes and objectives of industrial arts needed clarification and definition. Programs that demonstrated the distinctive nature and importance of industrial arts were needed. Since there was no national organization to promote industrial arts and few state organizations such exemplary models did not exist. Leadership in the field was at a low ebb. Many capable persons in industrial arts changed to vocational education because of higher salaries and better positions which resulted from the passage of the Smith-Hughes Act of 1917. The conflict, the confusion and the lack of leadership began to change mainly through the vision, ability and dedicated efforts of William E. Warner.

William Everett Warner was born in Roanoke, Ill., on August 22, 1897, the only son of Isaac Newton and Eva Redmon Warner. He began his education at the Model School of Illinois State Normal University in Normal and continued in the public schools of Chicago

while his father worked on his degree at the University of Chicago. William Warner completed high school at the demonstration school of the Normal School, Platteville, Wis., and completed the 3-year teacher training course at Platteville in 1917.

Throughout his education, Warner had the opportunity to work with several strong personalities and outstanding teachers such as V. M. Russell, Ira S. Griffith, William H. Varnum, David Snedden, Frederick Bonser and John Dewey. All had a profound effect upon the life and future of William E. Warner. Warner was to become the person with a philosophy and a message for industrial arts that were badly needed.

Upon completing his work at Platteville, Warner taught in several Wisconsin schools and served as an assistant principal at a vocational school at Wausau. While teaching at Stevens Point, Wis., he met Eleanor Todd, an elementary school teacher. They were married on August 14, 1920. After their marriage, Warner returned to school completing his Bacelor of Science and Master of Science degrees at the University of Wisconsin and the Doctor of Philosophy degree at Teachers College, Columbia University.

Warner was appointed assistant professor of Industrial Arts Education at The Ohio State University in 1925 and reached the rank of full professor in 1939. With the exception of 3 years during World War II and 3 years as executive director of Civil Defense for the state of Ohio, he spent his entire career at The Ohio State University. He retired in 1967 as professor emeritus.

William E. Warner introduced and developed the graduate program in industrial arts education at The Ohio State University. In a short time it attracted outstanding teachers in the country to the university to do graduate work. Warner inspired them with the concept of a new and broader industrial arts. He challenged them to develop their leadership capabilities. Warner emphasized the importance of experimentation and research related to the purposes and objectives, philosophy, curriculum and laboratory facilities of industrial arts education. He also stressed the importance of public school personnel having the opportunity to become better versed about these aspects of the subject. Through his many years of working with students at Ohio State and the professional organizations he founded and fostered, Warner helped to transform the scope, nature and prestige of industrial arts.

Dr. Warner made a significant contribution to industrial arts in general with his contribution of Terminological Investigation. The result of this research and study was a much needed clarification of terms and an important new definition of industrial arts:

> Industrial Arts is one of the Practical Arts, a form of general or non-vocational education, which provides learners with experience, understanding, and appreciation of materials, tools, processes, products and of the vocational conditions and requirements incident generally to the manufacturing and mechanical industries.
>
> These results are achieved through design and construction of useful products in laboratories or shops, appropriately staffed and equipped, supplemented by reading, investigations, discussions, films, visits, reports, and similar activities characteristic of youthful interests and aptitudes in things industrial.
>
> The subject of Industrial Arts belongs peculiarly within junior and senior high school areas for such purposes as exploration, guidance, the development of avocational and vocational interests and aptitudes, specific manual abilities, desirable personal-social traits growing out of industrial experiences, ability to choose and use industrial products wisely, all coupled with the aesthetic relationships involved. In general, its purposes are educationally social rather than vocationally economic, although in the senior high school it may increasingly emphasize vocational objectives in a non-legal sense, for certain students.
>
> Industrial Arts includes such industrial representations as drawing and design, metal work, wood work, textiles, printing, ceramics, automotives, foods, electricity, and similar units, either as separate offerings or in various combinations common to the "General Shop" or Laboratory of Industries.
>
> The term laboratory is more appropriate when the offering is provided upon an experimental or developmental basis, as is commonly done in the junior high school; and the term shop may be more appropriate where the work is carried on rather upon the production or economic basis, as may be done in the senior high school.[1]

After completing Terminological Investigation, Warner focused upon curriculum development. His first important contribution in this area was Ohio Prospectus. It was

designated as a committee report, but apparently was largely the work of Dr. Warner. Warner took the insights and the concepts of Bonser and Dewey and applied them to industrial arts. The Prospectus was the first state bulletin which attempted to state the role of industrial arts and the most thorough philosophical statement made by any state. It served as the forerunner of bulletins for other states and numerous other leadership developments in Ohio and across the nation.

Dr. Warner was the prime mover in the formation of the first Conference Committee for Industrial Arts Education organized by the United States Office of Education. In 1937, this committee published the first national report for the subject area: Industrial Arts: Its Interpretation in American Schools. The report included information on its objectives, curriculum, administration and supervision at all educational levels. It was based on Warner's new concepts for industrial arts first presented in Ohio Prospectus.

Ten years after the national report, Warner expanded on his philosophy and curriculum concepts at the American Industrial Arts Association meeting in Columbus, Ohio. At that meeting, Warner presented The New Industrial Arts Curriculum, later designated as The Curriculum to Reflect Technology. The curriculum itself was built upon the study of power, transportation, manufacturing, communications and management which were more related to modern technology than were the traditional areas of woodworking, metalworking and drawing. Even today these curriculum concepts are affecting the direction of industrial arts nationwide.

With Ohio Prospectus, Industrial Arts: Its Interpretation in American Schools, and The Curriculum to Reflect Technology, Warner helped to define and clarify the meaning and purposes of industrial arts within general education. He stressed the importance of social-economic factors, material culture and heritage, consumer literacy, education for leisure activities, and technology. The effect of this work was felt at all educational levels, but most of all at the secondary level where drastic changes took place.

His concept of industrial arts as general education was that it should provide students with a broad orientation to industry and the industrial society through exploration and experimentation. This required use of a wide variety of tools and materials and involvement in many processes within an integrated learning situation. The industrial arts facilities of the 1920's and 1930's were not designed, arranged or equipped for such a study. As early as 1922, Warner began working with the general shop and later refined his ideas into what he called the laboratory of industries to meet the special needs of the new industrial arts curriculum. He promoted the general shop and laboratory of industries through his writings in professional publications, encouraging his graduate students to do research on shop planning and equipment through providing exhibits and conferences on school shop planning and equipment selection and through consulting work with equipment companies and school systems. In these ways he encouraged better planning and designing of facilities and selecting of equipment for industrial arts.

With the program suggested in Prospectus and the facilities and equipment recommended for the laboratory of industries, the new industrial arts was ready for adoption in the Ohio schools. Warner and his co-workers seized upon the idea of creating developmental, exemplary programs in selected schools to serve as models for the teaching and learning of the new industrial arts. Both large and small schools were involved.

As chairman of the Ohio Committee on Coordination and Development of Industrial Arts Professional Interests, Warner enlisted financial aid from the Ohio State Department of Education for two centers — in other cases, local schools and county boards supplied funds. In still other instances new buildings were built with a federal subsidy from the Public Works Administration and the Works Progress Administration. Warner usually selected the teachers for the programs from among his students. He consulted with boards of education and architects concerning the facilities and program.

These programs were successful. They demonstrated that a broad, comprehensive program of industrial arts as a general education subject could be carried out in a wide variety of situations. Many educators throughout Ohio and from other states came to observe at these centers.

Dr. Warner also contributed significantly to the industrial arts profession in Ohio through his work as chairman of the State Steering Committee for Industrial Arts. The committee created interest in the subject and formulated a state program of industrial arts through its support of the publication of Ohio Prospectus. This relationship was furthered with Warner's work on Ohio High School Standards of 1937 and industrial arts teacher certification and preparation in the state. Through the committee Warner obtained

for a statewide conference on school shop planning and support of the developmental programs was assured. The comprehensive program sponsored by this committee was instrumental in the long range development of industrial arts in the state and eventually led to the formation of the Ohio Industrial Arts Association.

Warner also contributed to the industrial profession with the founding of two organizations. The first was Epsilon Pi Tau, ary professional fraternity in industrial arts and vocational education which ded in 1929 at The Ohio State University. Its main purpose was to recognize and promote leadership in the field by recognizing teaching skill, social efficiency and effective research. The fraternity has since promoted these purposes through formus, research, publications and various awards and scholarships. Dr. Warner worked faithfully as the executive secretary of Epsilon Pi Tau for some 40 years. The history of Epsilon Pi Tau itself reflects Warner as a thinker, energizer and organizer. He emphasized refinement, social efficiency and personal professional growth.

The second organization Warner contributed significantly to was the American Industrial Arts Association. The 10th Anniversary of Epsilon Pi Tau was the occasion for its founding. Dr. Warner offered leaders and persons involved with industrial arts teacher education an "Invitation to a National Conference." At the conference he outlined a 60-point program for the derivation, definition and projection of a program leading to the baccalaureate degree. During its second day a skeleton constitution for the American Industrial Arts Association was formulated and approved. It was at this conference held in Cleveland, Ohio, in 1939 that Dr. Warner was elected AIAA's first president serving for 2 years. He also served as the first editor of the Industrial Arts Teacher. Through his work to obtain departmental status for the Association in the National Education Association, and in other ways, he greatly influenced the direction and growth of the association in the early years of its existence. In 1970, Dr. Warner was presented a plaque and an international tribute for his role in the founding of the American Industrial Arts Association.

William E. Warner was an educator for 50 years. During these years he was especially interested in developing quality teacher education programs which would in turn produce effective leadership for the profession. His doctoral dissertation projected a program related to the preparation of teachers for junior high school industrial arts. Dr. Warner worked with the Ohio Industrial Arts Committee and the State Board of Education in Ohio to upgrade the standards of teacher education programs in the state. As a part of his concern for quality professional education and training, he developed an outline for industrial arts teacher preparation titled "The Three Degrees: Assumptions and Patterns."

As an educator, Warner consulted and lectured extensively. As a teacher, he was at his best with graduate students where he could emphasize the philosophical aspects of industrial arts and explore his many new ideas.

Dr. Warner made industrial arts exciting. He made his students feel that they could play a significant role in the field. He challenged them to leadership and greatness. Dr. Warner took a great deal of interest in his students both in and out of the classroom. Even after students completed their work with him, he would help them in their professional growth and in their consideration of job opportunities whenever possible. Through his long teaching career, he helped to mold the lives and futures of countless numbers of industrial arts teachers and leaders across the country and around the world. His educational philosophy centered on an industrial arts which was general education, an industrial arts which would meet the orientational, technical, recreational and consumer-cultural needs of persons at all levels of education. He was extremely dedicated to this concept of industrial arts and worked untiringly for its realization.

Warner was widely recognized as an educator; he received numerous awards and citations for his work. His last was a commendation from the Ohio House of Representatives awarded only a few days before his death.

Dr. William Everett Warner was one of the most important educators in the field of industrial arts education. Many persons have said that he was the leader for some years. Through his insight, energy and dynamic nature, he encouraged others to be leaders and innovators and to make industrial arts a field of which we all can be proud. Truly William Everett Warner was an innovative pioneer of industrial arts.

FOOTNOTE

1. William E. Warner and others. "The Terminological Investigation." Indianapolis, Ind.: Western Arts Association, 1933. p. 37.

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A Historical Look at the Founder of Industrial Arts Education: Frederick Gordon Bonser

William H. McPherson

> ...I do know that if we doubt ourselves, we will persuade no one; if we doubt our mission in the world, we will do nothing further to advance it, ...to view our present and our future with sickly anxiety is to ignore the lessons and achievements of our past.

The preceding quote by the late Adlai E. Stevenson was directed at the citizens of this country, and particularly at the young. Yet, its meaning has strong implications for those in the field of industrial arts education. One only has to look at the professional journals to see uncertainty in ourselves and our mission in the educational world developing within the profession. Our present and our future are viewed by many with anxiety and uncertainty.

What is industrial arts education? Teachers, principals, friends and neighbors, even industrial arts teachers are asking this question. Graduate students are asked to define industrial arts education and/or compare it with vocational education and general education. Who are we? Why are we here? Why the questions? Does industrial arts education have an identify crisis? There is no doubt that confusion exists and that some true soul searching is needed by the profession to end the debate and re-identify ourselves. If Adlai E. Stevenson is correct, these developments may have occurred by ignoring the lessons and achievements in our past. Few areas in education are so lacking in understanding of their own past and/or history as is the field of industrial arts education.

As a person adopted at birth may someday search for his biological parents and his true identity, so must industrial arts education. An individual in search of his identity will inevitably turn to the past to find his roots, his beginnings. We in industrial arts education will find our identity in the past, and with it many answers for the future.

Industrial arts education had its beginning in the elementary school curriculum some 60 years ago... a fact that few industrial arts teachers are aware of. A leading figure in the early development of industrial arts education was Frederick Gordon Bonser. To better understand the influence this man had on industrial arts education and his contribution, it is important to look at the people and the institution that influenced Bonser's thinking. Bonser was associated with such great educators as: John Dewey, James E. Russell, Lois Mossman, Frank McMurry, William H. Kilpatrick, Edward L. Thorndike and many others. All these educators did much of their professional work at Teachers College, Columbia University. To look at the development of industrial arts education, we must understand the influence that Teachers College had upon education itself at the beginning of this century.

TEACHERS COLLEGE, COLUMBIA UNIVERSITY

Teachers College, Columbia University, was founded on the desire and need for an institution to train teachers in the area of industrial education. Two associations played an important part in the development of Teachers College. They were the Kitchen Garden Association and the Industrial Education Association, incorporated in 1880 and 1884, respectively. The latter was the outgrowth of the former. From 1884 to 1886 the Industrial Education Association grew rapidly; its annual budget grew in a four-year period from $2,000 to over $38,000. In 1886, with the help of Miss Grace H. Dodge, the association moved into a renovated building. The repairs and equipment cost over $100,000. With new facilities and growing pressure, the association was to take on new responsibilities. At a time when industrial education was getting much publicity, the association was forced to focus its attention upon the training of teachers. In order to undertake this new task, a reorganization of the association itself was necessary. Both Alexznder Webb, the president, and Miss Dodge, vice president, stepped down; the running of the association was put in the hands of a Board of Trustees. "Ten Articles of Faith" were drawn up by the trustees stating the association's principles and aims and "to guard its work from 'degenerating into a manual training school'."[9] One of the aims, as stated in the "Ten Articles of Faith", stressed the importance of industrial training combined with general education...."[9]

It is no coincidence that this "Article of Faith" expresses one of the fundamental concepts and/or principles of industrial arts education — i.e., industrial arts is a vital part of general education.

The newly elected president of the association, Nicholas M. Butler, organized the "New York College for the Training of Teachers." One year after Dr. Butler's resignation from the association in 1892, the college was granted its permanent charter and its name was changed to "Teachers College." (In 1894 Teachers College moved to West 120th Street, New York City — its present location.

In 1897 James E. Russell was appointed head of the Department of Psychology and General Method at Teachers College. That same year he was elected dean of the institution. During Russell's years at Teachers College, the growth of the institution was rapid. In 1900 Teachers College listed 593 undergraduate students; in 1915 it had 1,999. In 1902 it had 83 graduate students, and in 1915 there were 619. When comparing Teachers College to other universities with graduate programs in education, Russell wrote in one of his annual reports:

> ...figures disclose the remarkable fact that Teachers College alone has during the academic year (1915-16) more matriculated graduate students in education than all other prominent universities in the United States and Canada combined.[18]

To many industrial arts teachers, James E. Russell, along with Frederick G. Bonser, is known for "The Russell-Bonser Plan" and/or "The Industrial Social Theory." These terms first appear in David Snedden and William Warner's book, Reconstruction of Industrial Arts Courses.[19]

In a search through James E. Russell's papers at Teachers College, interesting correspondence was found between William T. Bawden, then managing editor of the Manual Training and Vocational Education Magazine,[12] and Dean Russell. In a letter dated December 2, 1915, Dr. Bawden asked if Dean Russell would make a statement about future changes at Teachers College which would be of interest to the magazine's readers. What a statement it was! On December 15, 1915, Dr. Russell replied with the assertion that, due to the new emphasis in vocational education on skills and shop work as well as the ability to teach:

> We do not have the equipment, nor is it in accord with our plans, to specialize in the training of classroom teachers in this field. Consequently, we have decided to abandon all shop work of a highly technical or vocational character. In future our rooms, equipment, and endowment will be devoted to the strengthening of our work in industrial arts for the elementary and junior high school...[13]

It seems apparent from this correspondence that at this point in history the leader of the institution of higher education founded to train teachers in the field of industrial

education established the break between vocational education and industrial arts education. In doing so, Russell set the stage for the formulation of the development of industrial arts education as conceived by himself, Frederick Bonser, John Dewey, Lois Mossman, William H. Kilpatrick and others. Now let us look at the life and contribution of Frederick Gordon Bonser to our field.

EARLY EDUCATIONAL EXPERIENCES

Frederick Gordon Bonser lived between 1875 and 1931. He was raised on a farm in central Illinois where he attended the local rural elementary school As there was no high school near his rural home, he went to live with an uncle in Avon, Ill., in the fall of 1893. There he attended the local high school and managed to complete a four-year program in two years. He graduated in the summer of 1895, and in the fall of the same year enrolled at the University of Illinois.

He left the university after two years in order to teach in the rural schools of Illinois and Washington. In 1899 he returned to the University of Illinois; in two years he completed the requirements for a bachelor's degree with a major in psychology. Upon graduation, he was awarded a graduate fellowship in psychology which allowed him to work on his master's degree. He subsequently finished his master's degree in 1902. His major interests during his studies at the University of Illinois were in the fields of psychology and education.

CHEYNEY, WASHINGTON

After receiving his master's degree, Bonser accepted a position as Director of the Training School at the State Normal School in Cheyney, Washington. There he began his 28 years of work in teacher education.

During the three years he remained at Cheyney, Bonser directed a group of the faculty in developing a new curriculum for the training school. The curriculum developed by this group proposed that the work of the elementary school should include studies in industrial life, local environment through the related arts, and more content in science and history. Bonser believed that the proper selection of materials from these fields would be especially suited to the education of the child and would be valuable to him in interpreting life and in giving meaning to his common everyday experiences.

In order to communicate more effectively with the teachers in the vicinity of Cheyney, Wash., Bonser started a publication entitled The Normal Seminar. Through this publication, he began to disseminate his progressive philosophy of education, his concern for a more child-centered approach to education and for a more vital and practical curriculum.

In the spring of 1905, he was granted a graduate fellowship at Columbia University and subsequently resigned his position at Cheyney. As a doctoral candidate at Columbia University, Bonser's major field of study was educational psychology under the direction of Dr. Edward L. Thorndike.

MACOMB, ILLINOIS

Bonser left Columbia University in 1906, without completing his dissertation, to become a Professor of Education and Director of the Training School at Western Illinois State Normal School, at Macomb, Ill. As director, he led the training school faculty in revising the curriculum for the elementary school. During his years at Western Illinois, Bonser began to promote the educational philosophy of John Dewey by incproorating practical applications into the educational programs of the training school. By rotating groups of students through experiences in shop work, drafting, and home economics, Bonser is considered to have initiated the concept of the general shop and/or multiple activities.[18] Bonser began to establish a national reputation as an advocate of industrial arts in the elementary school through the articles he wrote for the Normal School Quarterly (a publication printed by the Western Illinois State Normal School) as well as from speeches he gave before the Illinois State Teachers Association. He advocated the development of an industrial arts curriculum as an activity-oriented study concentrated on the life needs of man — food, clothing and shelter. Bonser ended his work at Western Illinois to accept a position on the staff of Teachers College, Columbia University.[15]

BONSER'S RETURN TO TEACHERS COLLEGE, COLUMBIA UNIVERSITY

On his return to Teachers College in 1910, he completed his dissertation and was appointed Assistant Professor of Industrial Arts and Director of the Speyer School. As a member of the Teachers College faculty, Bonser became a leader in the area of elementary education and an advocate of the use of industrial arts to enrich the total school curriculum. The Speyer School had been set up ten years before Bonser took over as director. It was initially established as an experimental and demonstration school for Teachers College, Columbia University.

The Speyer School offered Bonser the opportunity to put into practice some of the ideas he had written about and experimented with while at Cheyney, Wash., and Macomb, Ill. In 1910 Bonser reaffirmed his philosophy of education and the role of industrial arts developed earlier in the article, "Fundamental Values in Industrial Education."[1]

THE INDUSTRIAL SOCIAL THEORY

The Industrial Social Theory can be found in a booklet entitled Industrial Education.[17] This booklet contains two articles: "The School and Industrial Life" by Russell and "Fundamental Values in Industrial Education" by Bonser. Both articles were attempts to focus attention on the importance of studying selected industries in a technical-industrial society. Bonser and Russell criticized the manual training movement of that time. They concurred that their theory of industrial arts would bring about a curriculum that would integrate all the school subjects into a more meaningful educational experience. The significance of this "theory" is that it stressed the importance of introducing the study of industry into the elementary school. Both men saw industrial arts as the discipline to undertake the study of industry. By an organized study of the vital industries which provide for man's basic life needs (food, clothing and shelter), an understanding of the industrial fiber of society could be gained. Dean Russell's article was considered by Snedden and Warner as "laying the foundation for the present study of industrial arts."[19] The two articles are very similar and can be thought of as the formulation of a single concept by two men.

Bonser's position as to the place of industrial arts in the elementary school curriculum was stated in this 1911 article and can be traced back to his earlier writings and speeches on industrial arts. Some researchers have implied that Bonser's article was nothing more than a rewrite of Russell's article, simply because the two were similar and Bonser's was written some two years after Russell's. The evidence that I found does not support this point of view. First, Russell's article was a collection of thoughts and ideas of the faculty at Teachers College — this can be documented. Secondly, Bonser's earlier writings (in particular, "A Syllabus of Educational Principles for Professional Discussion" printed in The Normal Seminar, September 1904) stressed Bonser's main point of view. In the article, "Industrial and Social Work in the Elementary School" (printed in March 1909, in the Normal School Quarterly), Bonser so closely followed the main thought and ideas of his 1911 article that it could be interpreted as a forerunner to that article and would indicate that Bonser had been formulating these ideas for some time.

The implementation of these ideas was carried out in the Speyer School from 1910-1913 while Bonser was the director. The work at the Speyer School was presented The Speyer School Curriculum of 1913.[20] This publication outlined the type of classroom activities that were carried on in this activity-oriented curriculum. The significance of this new curriculum approach to education was reflected by the continued sale of the publication long after the Speyer School was discontinued. The publication subsequently passed through several reprints.[14]

The school's basic aim, "social efficiency," was to be achieved through implementing the following principles:

> 1. The curriculum of the school should represent the needs and interests of present day life in our own immediate environment and the world at large, the social factor.
> 2. The work, at any given stage of the child's development, should be that which is adapted to the immediate enrichment of his life as measured by his individual needs and capacities, the psychological factor.[20]

Two corollaries to the foregoing principles were presented. The first of these was the principle that the school must be democratic enough to provide an education for what the

article called "concrete thinkers" (those that manage things, affairs and people) as well as for the "abstract thinkers" (those that manage ideas and think in terms of symbols). The second corollary embodied the idea that the school must provide real life experiences in an active and participatory way. Emphasis was to be placed on the importance of the industrial, commercial and economic aspects of society as vital parts of the education of children. But of paramount importance was:

> Through and through, the courses of study are humanistic — a means of participating in life's activities and interpreting them in terms of their value for human well-being.[20]

Bonser's work as Director of the Speyer School came to a close in 1913. He returned to full time teaching as a Professor of Education at Teachers College. His later interests involved him in many areas of education. This range of interests was quite noticeable in his later works, which included such topics as elementary education, secondary education, industrial arts, home economics, art education, fine arts, music, curriculum making, teacher training, developing creative ability in students, and the satisfactions of life itself.

At this point I would like to leave Bonser for a few minutes and discuss the influence of John Dewey on the thinking of Frederick Bonser. There is a close relationship between Dewey's psychology of occupations and Bonser's psychology of industrial arts.

JOHN DEWEY, THEORY OF OCCUPATIONS

John Dewey's "psychology of occupations" (or theory of occupations), as the basis for the elementary school curriculum, was an outgrowth of his work as the Director of the Laboratory School at the University of Chicago from 1896 to 1904.

Dewey defined the term "occupations" as a "mode of activity on the part of the child which reproduces, or runs parallel to, some form of work carried on in social life."[10] This definition has within it the characteristic of remaining timeless. For as the "work carried on in social life" changed with time, the school would therefore have to develop new modes of activities. One of Dewey's main themes in his education reform (that of socializing education) was also brought out in this definition. Dewey's social education brought about an integration between the individual and society. His new approach to education was accomplished by redesigning the traditional school so that it would function as a form of "community-life." He held that the great waste in schools was their lack of relating subject matter to everyday experiences and, in turn, relating daily experiences to school. The school, Dewey observed, was in isolation from life itself.

The "ocupations" were a means to an end. They were designed to bring about the socialization of the child. The child would respond with his natural instincts and interests and would thereby learn to be a part of society, a part of the world outside the classroom. Experiences outside the school were inherent in Dewey's definition of "occupations." These experiences included activities that were both familiar to the child and common to his home and surrounding environment.

Dewey selected activities which were of interest to children and at the same time possessed educational value, that provided for the fundamental needs of man such as food, clothing and shelter. Activities concerning these needs were considered basic and timeless; as they were already known to the child, they would tend to arouse his interest and stimulate his educational efforts. Along with being "basic," the activities provided ways for using, as far as Dewey was concerned, the four natural instincts of the child. These natural instincts were (1) the constructive, which employed simply physical coordination and developed into the use of tools and technical skills; (2) the investigative and experimental; (3) the social, which provided a means for the child to share and communicate his experiences; and lastly, (4) the expressive.[10]

FREDERICK BONSER, PSYCHOLOGY OF INDUSTRIAL ARTS

Bonser's psychology of industrial arts evolved around the "child-centered" concept. This concept considered as paramount both the interests of children and an understanding of their "inner and outer environment." Bonser maintained that it was vital to the learning process to know the inner workings of children: How they learn, why they react as they do, and an awareness of their home and community life.

Bonser held that the main purpose of education was the socilization of children. His educational goal was to provide a child with the ability to live and function effectively within an industrial society. Bonser stressed that through an activity-oriented curriculum (industrial arts), one wherein a child could relate life experiences to school life, a child could better cope with life itself. Bonser considered the things of everyday life as "life needs" and wanted to make them educational. The school and education were not to be isolated from life — home, work, community, and society.

According to Bonser, the specific purposes or objectives to be accomplished in industrial arts were (1) a health purpose, (2) an economic purpose, (3) an art or aesthetic purpose, (4) a social purpose and (5) a recreational purpose. These purposes were to be accomplished by utilizing the psychological or natural impulses of children toward expression or action.[5] Bonser identified six psychological impulses naturally expressive in children. They were (1) the impulse to manipulative activity, (2) the impulse to investigate, (3) the impulse to art activities, (4) the impulse to play, (5) the impulse to communicate and (6) the social impulse.[5]

The role of industrial arts was to contribute to the development of these natural impulses into effective habits or attitudes by providing educational direction. The educational experiences should therefore be based on the child's physiological and mental growth.[8]

A close correlation can be seen between Dewey's psychology of occupations and Bonser's psychology of industrial arts. While Dewey identified four natural instincts of the child around which the activities of the school curriculum were to be developed, Bonser identified six natural impulses in children to be used in the study of industrial arts. Bonser basically accepted Dewey's four common instincts in children; he identified the four in his list of six natural impulses in children.

WILLIAM H. KILPATRICK — THE PROJECT METHOD

William H. Kilpatrick joined the faculty of Teachers College in 1913 and became the interpreter and disciple of John Dewey. He was one of the most popular as well as controversial professors at Teachers College. He became known for his "Project Method." In 1918, Dr. Kilpatrick published an article, "The Project Method — The Use of the Purposeful Art in the Educative Process."[11]

Professor Kilpatrick began his article with a discussion of the word "project." He suggested that the word "project" must pass the test of two questions. The first was whether there was a desire and/or need for such a term that would give appreciable service to educational thinking. The second question asked whether the term "project" fitly designated the waiting concept. Kilpatrick went on to declare that since the name of the concept was unimportant in comparison to the concept itself, his main discussion would deal almost exclusively with the first of the two inquiries mentioned. He therefore suggested that some other term, such as "purposeful art," could be used for this concept. For Kilpatrick, this new concept must emphasize action, "preferably whole-hearted vigorous activity," and must follow ethical qualities of conduct as well as use the laws of learning.

Kilpatrick went on to question whether or not a term could be found; he concluded that the term to be found would be a concept engulfed in purposeful activity taking place in a social environment. Kilpatrick then defined the term "project:" "It is to this purposeful act, with the emphasis on the word purpose, that I myself apply the term 'project'."[11]

Professor Kilpatrick acknowledged that he neither invented nor introduced the term to the educational community. He did, however, acknowledge that he had given the term a new meaning. If, as a synonym to Kilpatrick's "project," the phrase "hearty purposeful act" was used, his new term would take on a much more meaningful concept. Kilpatrick tied the term project to life. If the purposeful act were a typical unit of the worthy life in a democratic society, this purposeful act should then be made the typical unit of school procedure. If this were done, the goal that education should be life itself, and not mere preparation for later living, would be accomplished. If this format were followed, education would indeed become life.

BONSER AND MOSSMAN'S WORK

Lois Mossman had worked with Bonser before coming to Teachers College in 1910. Both worked at the Speyer School (an experimental school for Teachers College). Mossman

was a staff member, while Bonser was the school director. The booklet, The Speyer School Curriculum,[20] is a product of their efforts at the school.

Lois Mossman continued to work with Bonser after they both left the Speyer School and became members of the faculty at Teachers College. In their book, Industrial Arts for Elementary Schools,[5] published in 1923, we find the first definition of industrial arts. A new emphasis can be seen emerging in the introduction of this book. The desire to have children investigate, inquire and experiment as well as appreciate, manipulate and construct is emphasized. After making a distinction between industrial arts and fine arts, the introduction concludes with their widely published definition of industrial arts:

> The industrial arts are those occupations by which changes are made in the forms of materials to increase their values for human usage. As a subject for educative purpose, industrial arts is a study of the changes made by man in the forms of materials to increase their values, and of the problems of life related to these changes.[5]

When referring to the purpose of industrial arts, the authors make a clear distinction between vocational and general education. Vocational education is studied "for the sake of developing skill and efficiency in producing in this particular industry."[5] Its fundamental purpose is the development of efficient workers: it is highly specialized teaching. Bonser and Mossman conclude that "clearly such work has no place in the elementary school nor in the early years of junior high school."[5] Under the discussion of general educational purpose, it was stated that the study of industrial arts helps one to become more efficient in the selection, care and use of products made in the more important industries. In contrast to vocational education, productive skills are not the end product. The study of industrial arts concerns itself with man's common needs — food, clothing, utensils, household furnishing and other products of industry. The specific purpose or objectives of industrial arts are "(1) a health purpose; (2) an economic purpose; (3) an art or aesthetic purpose; (4) a social purpose; and (5) a recreational purpose."[5] The book is an example of Bonser and Mossman's philosophy and how this philosophy could be implemented in the elementary school curriculum.

BONSER'S DEFINITIONS OF INDUSTRIAL ARTS

Though we have discussed Bonser's most widely publicized definition of industrial arts education, Bonser was responsible for several more. Bonser's repeated modifications of these definitions were expressed throughout his extensive writings. A compilation of several of these definitions (including the 1923 definition) is listed below.

> 1913
>
> It means a well-organized body of thought, giving insight into industrial materials, industrial methods and the social aspects of industry; it means a study of the evolution of industry, showing how the complex factory system with organized capital, organized labor, and highly specialized machine production has grown from the simplest beginnings; it means a most practical study of design — of the principles of design in relationship to their appropriate usage in specific products — as design is used today and as it has developed among participation through the making of many projects — more design and hand work than we have had in the past, not less — all chosen with reference to their appropriateness to illustrate the major principles of design and construction, and the fuller appreciation of the industry which they represent.[2]
>
> 1914
>
> ...those arts relating to the changes in materials by which they are made into finished products, thereby becoming both more useful and more beautiful for the satisfaction of man's needs. This includes those changes in woods, metals, clays and other earth materials, textiles, food materials, and so on, usually called broadly, manufacture.[3]
>
> 1920
>
> The industrial arts represent the changes made by man in the raw products of nature to make them more usable as food, clothing, shelter, utensils, tools and machines, and records of his experiences, as books and periodicals.[4]
>
> 1923
>
> The industrial arts are those occupations by which changes are made in the forms of materials

to increase their values for human usage. As a subject for educative purpose, industrial arts is a study of the changes made by man in the forms of materials to increase their values, and of the problems of life related to their changes.[5]

1927

Industrial arts as a school study consists of activities through which we deal directly with the health, economic, appreciative, and social values derived from considering the production and use of the material supplies by which we maintain daily life. It provides such activities, mental and physical, as bring out values of both personal and social importance relative to food, clothing, shelter, utensils, and other material products which afford us the necessities, the comforts, and many of the luxuries of life.[6]

1928

By industrial arts we mean a study of the ways and means by which we are efficiently supplied with the materials and products which we use in daily life. This includes the study of the changes we make in raw materials to increase their value for usage, the study of selection in relationship to purposes of usage, the study of selection in relationship to purposes of usage, a study of the care and upkeep of products possessed, and a study of the social responsibilities we should share as a result of the methods and practices of industrial production and distribution.[8]

1930

A study of the changes man makes in materials to increase their values to meet needs of the appropriate usage of products made, and of the social advantages and problems resulting from the making of these changes and products.[7]

Many historians within the field of industrial arts education consider Bonser's 1923 definition as the first definitive statement on industrial arts education. However, Bonser had published definitions of industrial arts education prior to 1923. From the chronology of the above list, a shift in emphasis is discernable in the later definitions of industrial arts as an area of study; Bonser began to place more emphasis on the importance of consumer knowledge and products as an educational outcome of the industrial arts program.

UNITS OF STUDY IN INDUSTRIAL ARTS EDUCATION

The basis for Bonser' curriculum in industrial arts (that industrial arts was to concern itself with man's basic needs — food, shelter, clothing) remained constant throughout his career. Bonser considered the organization of industry the key to bring the study of the industries into the elementary school curriculum. At the Speyer School, he experimentally worked with an organization based on a "materials concept" which was an implementation of the approach advocated by Russell. Bonser later modified this concept for a new organization based on the use of products. This change was brought about because Bonser's work at the Speyer School indicated that there was no unity in materials as materials. Such raw materials as clay, metals and wood, for example, enter into many industrial fields far removed from one another. This diversity gave little sense of unity or continuity in the organization of the industries themselves.

A new form of classification was therefore needed. This new classification was products, justified on the grounds that the basic needs of man are based on products rather than on raw materials.[5] The changes that Bonser made in the units of study can be seen by looking at the following.

1910

"food products, textiles, wood products, iron and other metals, and clay and allied earth products."[1]

1913

"foods; shelter; clothing; records; utensils; and tools, machines and weapons."[20]

1923

"food; clothing; shelter; utensils; records for transmitting experiences; and tools and machines."[5]

1930

"(1) food; (2) clothing; (3) shelter and home furnishing; (4) utensils; (5) tools and machines; and (6) records, or books and other publications."[7]

While Bonser did modify his initial units of study, the basis or structure for his curriculum remained constant: Man's basic needs of food, clothing, and shelter.

Bonser's lifelong interest in an "activity-oriented" curriculum led him to accept the chairmanship of the Committee on the Activity Movement, National Society for the Study of Education. This committee was charged with the responsibility of producing a yearbook on the activity movement. Bonser never saw the completed product, entitled The Thirty-Third Yearbook of the National Society for the Study of Education/Part II The Activity Movement; it was published three years after his death.

CONCLUSION

It seems apparent that our roots are founded in the work of such educators as James E. Russell, Lois Mossman, John Dewey, William H. Kilpatrick and others in the Progressive Education Movement. They developed an educational philosophy of which industrial arts was a vital part. They denounced manual training and clearly distinguished between vocational and industrial arts education. Their philosophy was child-centered, for both boys and girls, activity-oriented and very humanistic; they viewed industrial arts as an integral part of general education.

As a vital member of this group, Frederick Gordon Bonser was known for his many contributions to education, especially in the field of elementary school curriculum. His educational philosophy, based on man's "life needs," was that of general education for both boys and girls (regardless of their future vocations) in an industrial society. This philosophy was an evident rejection both of the traditionalists' approach to education and of the manual training movement.

Bonser is also recognized for his three major contributions to industrial arts education. One was his widely publicized definition of industrial arts, considered to be the first such definitive statement in the field. A second contribution attributed to Bonser was the role he played in organizing the first general shop (multiple activities) at both Western Illinois State Normal School, Macomb, Ill., and Teachers College, Columbia University. Finally, with James E. Russell, Bonser was responsible for the "Russell-Bonser Plan" and/or "The Industrial Social Theory" of industrial arts education. This theory was considered the basis for the development of industrial arts in the elementary school.

Today there are many who would equate the beginning of industrial arts with the "Russian System" shown at the Centennial Exposition of 1876. Calvin M. Woodward's opening in 1880 of the St. Louis Manual Training School, modified after the Russian System, was the start of manual training schools in the United States. The year 1876 should commemorate the beginning of manual training, which is a forerunner of the trade school — with which industrial arts had and has NO association. If we as industrial arts educators can associate our beginnings with the great progressive educators of the 20th Century and divorce ourselves from the manual training movement of the late 19th Century, a great step forward will have been made. The confusion as to who are we and how we fit into general education will be reduced greatly. We may need to redefine our goals and objectives in the future for a post-industrial society. By understanding our true heritage, we will face a more meaningful and easier task. We have a proud and prestigious beginning that we can ill afford to forget. Let it be the beginning of a new future for industrial arts education.

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An Interpretation of the Ideas, Philosophy and Contributions of Frederick Gordon Bonser

William H. McPherson

> I do know that if we doubt ourselves, we will persuade no one; if we doubt our mission in the world, we will do nothing further to advance it, ...to view our present and our future with sickly anxiety is to ignore the lessons and achievements of our past.

The preceding quote by the late Adlai E. Stevenson was directed at the citizens of this country and particularly at the young. Yet its meaning has strong implications to those in the field of industrial arts education. One has only to look to the professional journals to see developing within the profession uncertainty in ourselves and our mission in the educational world. Our present and our future are viewed by many with anxiety and uncertainty. If Adlai E. Stevenson was correct, these developments may have accured by ignoring the lessons and achievements of the past. Few areas in education are lacking the understanding of its past and/or history as is the field of industrial arts education.

Herein lies the purpose of this presentation. Industrial arts education got its beginning in the elementary school curriculum some 60 years ago. A fact that few industrial arts teachers know. A leading figure in the early development of industrial arts education was Frederick Gordon Bonser. Frederick Bonser was one of the reformers and should perhaps be considered the founding father of industrial arts education.

Frederick Gordon Bonser lived between 1875 and 1931. His educational philosophy was developed in the industrial-social and economic setting of the United States at the turn of the century. This period was known not only for its unprecedented social and economic growth but for its educational reform as well. This period was also one of

great population expansion, the growth of large industries and the evolution of large industrial cities with their vast urban social problems.

Education in the United States was also influenced by the writings of European educational theorists such as Johann Pestalozzi, Friedrich Froebel and Johann Herbart. The ideas and philosophies of these educators were studied in the United States by individuals such as Charles and Frank McMurry, Francis W. Parker and John Dewey. Through European influences American educators developed the progressive movement in education.

As an institution of higher learning, Teachers College, Columbia University, became one of the dominant centers of the new progressive education. As an educator and a prominent member of the faculty of Teachers College, Frederick Bonser played an important role in the development and implementation of new curricula to meet the challenges created by these social, economic and educational changes.

During Bonser's years at Teachers College, Columbia University, the college was under the leadership of James E. Russell (1897 through 1927). Under Russell's direction Teachers College attained international renown because of both its progressive educational philosophy and the stature of its faculty. During this era Teachers College had on its faculty John Dewey, Frederick G. Bonser, William H. Kilpatrick, Frank McMurry, William Russell (James E. Russell's son and his successor to the deanship), and Edward L. Thorndike. As a member of this group, Bonser became a leader in the area of elementary education and an advocate of industrial arts to enrich the total school curriculum even though he had no formal training or teaching experience in shopwork. He was also an unusually prolific writer. During his lifetime, Bonser wrote about 83 articles and contributed to the publication of at least 10 books.

One of Bonser's more important writings was "Fundamental Values in Industrial Education."[2] This article and one written by James E. Russell entitled "The School and Industrial Life" (1909)[13] later appeared in the booklet, Industrial Education.[14] The concepts advocated by the authors later came to be known to industrial arts educators as the "Industrial-Social Theory" and/or "The Russell-Bonser Plan."[16]

Both articles were an attempt to focus attention on the importance of studying selected industries in a technical-industrial society. They concurred that the industrial arts curriculum should integrate all the school subjects into a more meaningful educational experience. The thinking of both men was similar in that they saw industrial arts as an integral part of the school curriculum. They saw the study of selected industries as a means of bringing about a richer, more relevant and more child-centered.

The two men stressed the importance of studying the industries not only from their manufacturing concepts but from the economic and social influences imparted by these industries on an industrial society as well. They held that children should study the industries which dealt with their basic needs (food, clothing, and shelter); that industrial arts would find its content around five basic areas — food, textiles, woods, metals and clay and allied earth products. Within these areas or subjects the Industrial-Social Theory was to function.

Initially, Bonser's position as to the place of industrial arts in the elementary school curriculum as stated in this 1910 article can be traced back to his earlier writings and speeches on industrial arts. Some researchers have implied that Bonser's article was nothing more than a rewrite of Russell's article, simply because the two were similar and Bonser's was written some two years after Russell's. The evidence that I found does not support this point of view. Russell's article was a collection of thoughts and ideas of the faculty at Teachers College; this can be documented. Second, Bonser's earlier writings (in particular, "A Syllabus of Educational Principles for Professional Discussion" printed in The Normal Seminar, September 1904) stressed Bonser's main point of view. Also in the article, "Industrial and Social Work in the Elementary School," (printed in March 1909 in the Normal School Quarterly) Bonser followed so closely the main thought and ideas of his 1910 article that it could be interpreted as a forerunner to that article, and would indicate that Bonser had been formulating these ideas for some time.

These ideas were implemented at the Speyer School from 1910 through 1913 while Bonser was the director. The work at the Speyer School was presented in the publication The Speyer School Curriculum of 1913.[17] This publication outlined the type of classroom activities that were carried on in this activity oriented curriculum. The significance of this new curriculum approach to education was reflected by the continued demand and sale of the publication long after the Speyer School was discontinued. The publication subsequently passed through several reprints.[11]

The school's basic aim was social efficiency to be achieved through the implementing of the following principles:

1. The curriculum of the School should represent the needs and interests of present day life in our own immediate environment and the world at large, the social factor.
2. The work, at any given stage of the child's development, should be that which is adapted to the immediate enrichment of his life as measured by his individual needs and capacities, the psychological factor.[17]

Two corollaries to the foregoing principles were presented. The first was the principle that the school must be democratic enough to provide an education for what the article called concrete thinkers (those who manage things, affairs and people) as well as for the abstract thinkers (those who manage ideas and think in terms of symbols). The second corollary embodied the idea that the school must provide real life experiences in an active and participatory way. Emphasis was to be placed on the importance of the industrial, commerical and economic aspects of society as vital parts of the education of children. Of paramount importance was;

> Through and through, the courses of study are humanistic — a means of participating in life's activities and interpreting them in terms of their value for human well being.[17]

Bonser's work as director of the Speyer School came to a close in 1913. He returned to full time teaching as a Professor of Education at Teachers College. His later interests involved him in many areas of education. This range of interests was quite noticeable in his later works which included topics such as elementary education, secondary education, industrial arts, home economics, art education, fine arts, music, curriculum making, teacher training, developing creative ability in students, and the satisfaction of life itself.

The thinking of Bonser was influenced by John Dewey. A close relationship can be seen between Dewey's psychology of occupations and Bonser's psychology of industrial arts.

JOHN DEWEY, THEORY OF OCCUPATIONS

John Dewey's psychology of occupations (or theory of occupations) as the basis for the elementary school curriculum was an outgrowth of his work as the director of the Laboratory School at the University of Chicago from 1896 to 1904.

Dewey defined the term "occupations" as a "mode of activity on the part of the child which reproduces, or runs parallel to, some form of work carried on in social life."[10] One of Dewey's main themes in his educational reform (that of socializing education) was brought out in this definition. Dewey's social education brought about integration between the individual and society. His new approach to education was accomplished by redesigning the traditional school so that it would function as a form of community life. He held that the great waste in schools was their lack of relating subject matter to everyday experiences and, in turn, relating daily experiences to school. The school, Dewey observed, was in isolation from life itself.

The occupations were a means to an end. They were designed to bring about the socialization of the child. The child would respond with his natural instincts and interests and would thereby learn to be part of society, a part of the world outside the classroom. Experiences outside the school were inherent in Dewey's definition of occupations. These experiences included activities that were both familiar to the child and common to his home and surrounding environment.

Dewey selected activities which were of interest to children and at the same time possessed educational value. The activities selected for inclusion in the curriculum reflected those that provided for the fundamental needs of man. The activities included such fundamental needs as food, clothing and shelter. Activities concerning these needs were considered basic and timeless; as they were already known to the child they would tend to arouse his interest and stimulate his educational efforts. Along with being basic, the activities selected provided ways for using, as far as Dewey was concerned, the four natural instincts of the child. These natural instincts were: (1) The constructive, which employed simple physical coordination and developed "into the use of tools and technical skills;" (2) the investigative and experimental; (3) the social, which provided a means for the child "to share and communicate his experiences;" and (4) the expressive.[10]

FREDERICK BONSER, PSYCHOLOGY OF INDUSTRIAL ARTS

Bonser's psychology of industrial arts evolved around the child-centered concept. Both the interests of children and an understanding of their "inner and outer environment" were considered paramount in this concept. Bonser maintained that it was vital to the learning process to know the inner workings of children: How they learn, why they react as they do and an awareness of their home and community life.

Bonser held that the main purpose of education was the socialization of children. His educational goal was to provide a child with the ability to live and function effectively within an industrial society. Bonser stressed that through an activity-oriented curriculum (industrial arts), a child could relate life experiences to school life and better cope with life itself. Bonser considered the things of everyday life as life needs and wished to make them educational. The school — education — was not to be isolated from life: Home, work, community and society.

According to Bonser, the specific purposes of industrial arts were: (1) A health purpose, (2) an economic purpose, (3) an art or aesthetic purpose, (4) a social purpose and (5) a recreational purpose. The resulting objectives were to be met by utilizing the psychological or natural impulses of children toward expression or action.[6] Bonser identified six psychological impulses naturally expressive in children. They were: (1) The impulse to manipulate, (2) the impulse to investigate, (3) the impulse to do art activities, (4) the impulse to play, (5) the impulse to communicate and (6) the impulse to be social.

The role of industrial arts was to foster the development of these natural impulses and to reinforce effective habits and attitudes. The resulting educational experiences should therefore be based on the child's physiological and mental growth.[9]

A close correlation can be seen between Dewey's psychology of occupations and Bonser's psychology of industrial arts. While Dewey identified four natural instincts of the child around which the activities of the school curriculum were to be developed, Bonser identified six natural impulses in children to be used in the study of industrial arts. Bonser basically accepted Dewey's four common instincts in children identifying the four in his list of six natural impulses in children.

BONSER'S DEFINITIONS OF INDUSTRIAL ARTS

Through his many years of experience developing elementary school curriculum, Bonser continually worked to define more precisely the concept of industrial arts. Bonser's repeated modifications of these definitions were expressed throughout his extensive writings. A compilation of several of these definitions are:

1913

It means a well organized body of thought, giving insight into industrial materials, industrial methods, and the social aspects of industry; it means a study of the evolution of industry, showing how the complex factory system with organized capital, organized labor, and highly specialized machine production has grown from the simplest beginnings; it means a most practical study of design — of the principles of design in relationship to their appropriate usage in specific products — as design is used today and as it has developed among participation through the making of many projects — more design and hand work than we have had in the past, not less — all chosen with reference to their appropriateness to illustrate the major principles of design and construction, and the fuller appreciation of the industry which they represent.[3]

1914

Those arts relating to the changes in materials by which they are made into finished products, thereby becoming both more useful and more beautiful for the satisfaction of man's needs. This includes those changes in woods, metals, clays and other earth materials, textiles, food materials, and so on, usually called broadly, manufacture.[4]

1920

The industrial arts represent the changes made by man in the raw products of nature to make them more usable as food, clothing, shelter, utensils, tools and machines, and records of his experiences, as books and periodicals.[5]

1923

The industrial arts are those occupations by which changes are made in the form of materials to increase their values for human usage. As a subject for educative purpose, industrial arts is a

study of the changes made by man in the forms of materials to increase their values, and of the problems of life related to their changes.[6]

1927

Industrial arts as a school study consists of activities through which we deal directly with the health, economic, appreciative, and social values derived from considering the production and use of the material supplies by which we maintain daily life. It provides such activities, mental and physical, as bring out values of both personal and social importance relative to food, clothing, shelter, utensils, and other material products which afford us the necessities, the comforts, and many of the luxuries of life.[7]

1928

By industrial arts we mean a study of the ways and means by which we are efficiently supplied with the materials and products which we use in daily life. This includes the study of the changes we make in raw materials to increase their value for usage, the study of selection in relationship to purposes of usage, a study of the care and upkeep of products possessed, and a study of the social responsibilities we should share as a result of the methods and practices of industrial production and distribution.[9]

1930

A study of the changes man makes in materials to increase their values to meet needs of the appropriate usage of products made, and of the social advantages and problems resulting from the making of these changes and products.[8]

Many historians within the field of industrial arts education consider Bonser's 1923 definition as the first definitive statement on industrial arts education. However, as noted above, Bonser published definitions of industrial arts education prior to 1923. From the chronology of the above list a shift in emphasis is discernable in the later definitions of industrial arts as an area of study; Bonser began to place more emphasis on the importance of consumer knowledge as an educational outcome of the industrial arts program.

UNITS OF STUDY IN INDUSTRIAL ARTS EDUCATION

The basis for Bonser's industrial arts curriculum (concern with man's basic needs: food, shelter, clothing) remained constant throughout his career. Bonser considered the organization of industry the key to bringing such studies into the elementary school curriculum. At the Speyer School, he experimented with an organization based on a materials concept. This was the approach advocated by Russell. Bonser later modified this concept to accommodate a new organization based on the use of products. This change was a result of Bonser's work at the Speyer School which indicated that there was no unity in materials as materials. Raw materials such as clay, metals and wood, for example, entered into many industrial fields far removed from one another. This diversity gave little sense of unity or continuity to this means of organizing the industries.

A new form of classification was therefore needed. The proposed classification was that of products, justified on the grounds that the basic needs of man are based on products rather than on raw materials. These changes in the units of study can be noted in Bonser's writings:

1910

"food products, textiles, wood products, iron and other metals, and clay and allied earth products."[2]

1913

"foods; shelter; clothing; records; utensils; and tools, machines, and weapons."[17]

1923

"food; clothing; shelter; utensils; records for transmitting experiences; and tools and machines."[6]

1930

"(1) food; (2) clothing; (3) shelter and home furnishing; (4) utensils; (5) tools and machines; and (6) records, or books and other publications."[8]

Therefore while Bonser did modify his initial units of study, the basis or structure for his curriculum remained constant: man's basic needs of food, clothing, and shelter.

SUMMARY

Frederick Gordon Bonser is known for his many contributions to education, especially those related to elementary school curriculum. His educational philosophy, based on life needs, was that of general education in an industrial society. It was equally applicable to both boys and girls and had no relationship to their future vocations. This philosophy was an evident rejection both of the traditionalists' approach to education and of the manual training movement.

Bonser is also recognized for his three major contributions to industrial arts education. One was his widely publicized definition of industrial arts, considered to be the first such definitive statement in the field. A second was the role he played in organizing the first (multiple activities) general shop at Western Illinois State Normal School, Macomb, Ill., and at Teachers College, Columbia University. The third was the "Russell-Bonser Plan" and/or "The Industrial Social Theory" of industrial arts education. This theory was considered the basis for the development of industrial arts in the elementary school.

Bonser's lifelong interest in an activity-oriented curriculum led him to accept the chairmanship of the Committee on the Activity Movement for the National Society for the Study of Education. This committee was responsible for producing a yearbook on the activity movement. Bonser never saw the completed product, The Thirty-Third Yearbook of the National Society for the Study of Education/Part II The Activity Movement; it was published 3 years after his death.

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Technology—Past, Present and Future

Arthur J. Rosser

Technology has always been a part of our lives from the day man walked erect and extended the use of his hands and muscles through the invention and use of tools. Technology will always be with us in the future as man continues to use his skills and knowledge to extend himself with new tools, materials and equipment. Think of what man knows and does today on our bicentennial birthday. Where will he be when our nation is 250 years old? The year 2026 is not that far away; it is less than the lifetime of the average American today. Alvin Toffler in Future Shock divides man's 50,000 years of existence into 800 lifetimes of 62 years. Of this figure, Toffler estimates 650 of those was spent in caves. He points out that man has been able to communicate between lifetimes effectively for the last 70. Man has been able to use the printed word only during the last six lifetimes. More recently, during the last four lifetimes, man has been able to measure time accurately. He has had the advantage of the electric motor only within his last two lifetimes (Toffler, p. 14).

What will happen to technology during lifetimes 801 or 802? By the time lifetime 802 has ended, none of us who are alive today will see it.

The purpose of this presentation is explore the technologies of the past, the present and the future. For the purpose of this presentation, technology is defined as the processes, inventions, materials and tools of man at any place in time. Historically, we know that man has always had a technology. He even developed some technologies long before he was able to apply them. A great deal of technology has come from the systematic process of research and development through the trial and error process. Thomas Edison is probably a classic example of this approach. We must also remember that 90 percent of all scientists who have ever lived are alive today (Toffler, p. 27).

Let us now look at some of the technologies of the past. One must remember that at one point in time, 50,000 years ago, a cave or a stick hut was the latest form of contemporary shelter. The use of fire and stone tools were an innovation in their time. Man was beginning to learn about his environment and how to control it. Man's role in the early years was to provide food and shelter; to survive. He had no time to play cards or watch "The Waltons."

Clothing in the form of skins and movable shelters were two of man's early cultural and technological contributions to society. His early educational practice of teaching his offspring life-sustaining processes was a natural means of self-perpetuation.

As time passed, as man improved himself, and as society and culture developed, man developed the fundamental knowledge and skills on which a large portion of our present and future technology exists. Where would we be today without the principle of the Archimedes screw or the concept of the lever? Many of the building blocks of modern technology cannot even be attributed to a single person like Archimedes, Pythagoras, or Gutenberg. We don't know who invented the wheel, the windmill, the bow and arrow or the cannon. We do know, however, that much of technology was generated by war in ancient times.

The source of a great deal of technology can only be assumed, since the knowledge and skills of communication have been lost because of the lack of an understandable written language. Historians tell us, for instance, the Egyptians knew how to make 20 types of bread and also beer and wine. The process of mummification is a classic secret of ancient technology.

Most people look at technology before 1600 A.D. as having little or no effect on us. The interrelationship of ancient technologies to modern concepts is so complex, however, that the removal of a single one would have had a domino effect on all the technologies which followed. All technologies have a logical sequential pattern of development. Only after the total development of a technology has man been able to discover the easiest way to have accomplished the end product.

Some technologies have not changed conceptually since their invention or discovery. Many machines, in particular, look and perform as they did when they were invented. The only change may have been in the materials from which it is made, the processes by which it is manufactured or the source from which it gets its power. Some classic examples are the potter's wheel, textile looms and heavy machine tools such as turret lathes, milling machines, band saws and shapers.

Down through the last several centuries, particularly in the United States, one technology has fostered others. Economic or technological necessity has led to many inventions, discoveries and even fads. Technologically, we do not need a $12,000, 6,000-pound automobile to transport two persons to a cultural evening at Lincoln Center in New York. However, those same persons could not be transported in an 800-pound three-wheeled vehicle which travels 60 miles on a single gallon of fuel or a $.54 electrical charge. The social, cultural and economic side of our technology is not quite ready for it.

Our present technology is responsible for all of our environmental problems and other related ills. The technology is also responsible for our being capable of solving all of our problems if the public's priorities were aligned with the severity of the problem. The removal of all internal combustion engines in all motor vehicles would almost instantly clear the air and the skies. But let us face reality; the change will not and cannot take place instantly. The process will take a long time to complete economically, legally and practically.

Today, we refer to several new technologies as being "spin-offs" of others. Almost all of our future technologies will spin off the inventions or discoveries of today, as well as those of ancient times. Technology is very complex. Without it we could not function. We have come to depend on technology to create new technologies. One might relate this process to that of a fast breeder-type nuclear reactor. If technology is to survive and multiply, it must be maintained, directed and controlled for the good of mankind as he seeks to perpetuate himself, his culture and his society.

Some of the Buck Rogers-type technology of 20 years ago is a reality today. We have large aircraft that carry 400 people at 600 mph over long distances. Space satellites that transmit and receive radio and TV signals, snoop on our potential enemies and neighbors and give accurate pictures of weather patterns are part of our present technology. The picturephone is real in the offices of Bell Telephone research facilities. The Saturn V is man's largest controlled release of energy short of the irreversible hydrogen bomb. The Saturn V can be shut down if necessary.

Much of what we know about the future may come from learned forecasting or even pure speculation. Buzz Aldrin, writing in the foreword of Our World in Space, says:

> Man has increased his knowledge of the unknown so rapidly and effectively in recent years that he can now envision realistically what it is like where he is yet to go. The images ... are not fanciful dreams, but have a basis in reality; they are expressions of some of the imaginative striving toward the future. (McCall and Asimov, p. 11).

As a nation we have explored the moon. Aldrin, Armstrong and Collins were the first to walk on its surface in July 1969 — a culmination of what we might term "moon technology."

In Spring 1973, the world witnessed another American first in space in the form of Skylab. The technology of "good old American" ingenuity was used to rig a sunshade to cool the lab when a thermal shield was lost during the launch. Skylab added a significant amount of information to man's knowledge of space with its observations of the sun, its biomedical experiments, earth resource studies, mapping observations and tests on metals for future space manufacturing processes.

During Summer 1975 another milestone in space technology occurred when the joint Russian-American project of space docking was accomplished by Apoll-Soyuz. Space technology finally had a "cultural spinoff:" international cooperation.

What is the future of our technology? We are on the threshold of a new age of discovery. What are we going to find on July 4, 1976, when the Viking Lander makes its soft landing on Mars? Will we find a planet that is several thousands of years ahead or behind the Earth? Will we try to colonize the "Red Planet?"

What is beyond our soft landing on Mars? Many experts believe our next big thrust in technology will be the space-shuttle of the 1980's. Large booster rockets will carry orbiters into space. After the mission of the orbiter is over, it will return to Earth as an aircraft. Initially, only the external tank for orbit flight will be lost — the only unusable part of the shuttle system. Later, it is envisioned that the entire booster will be reuseable and manned. The orbiters will be used to haul payloads into space for building space stations or replenishing depleted supplies. From space stations, two-man service vehicles can be sent out to perform maintenance work on orbiting satellites or retrieve disabled space vehicles.

The future will also see shuttlecraft service stations. These will be able to handle

a wide variety of space vehicle configureations. Transportation centers of the future will probably be domed cities near launch sites. (McCall and Asimov, pp. 57-72). Man will also attempt to colonize the moon in the near future. Plexiglas-covered rovers with tractor-like treads will move people to and from hemispherical lunar housing units. Astronauts will move about the moon in individual maneuvering units: a personal space propulsion system. Subcrust-lunar cities will be a reality in the future. Solar energy, space shuttles and Earth ferries will be a result of technology of tomorrow. Circular cities on the surface of the moon may be an alternative for the people of the 21st century. (McCall and Asimov, pp. 89-96). What will the exploration and, perhaps, colonization of Mars look like during the 21st century? Will space posts, like large spheres, be the way stations for interplanetary travelers of the future? (McCall and Asimov, p. 121).

Technology has created our prosperity as well as our problems. At any place in time, there will be a technology of that time. The technologies of the past have included fire, the wheel and pyramids. Today we have television, lasers and communication satellites. The future of technology lies ahead.

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Industrial Arts in the Industrial and Postindustrial Society

Kendall N. Starkweather

> The historians of the future will say whether we used our knowledge and resources to perpetuate in vain a world which has ceased to exist, or whether we used our imagination and wisdom to build boys and girls who, in turn, created a better world.
>
> R. Lee Hornbake

How will we, in the field of industrial arts, design education which will allow for the use of one's wisdom and imagination in creating a better world? As educators we attempt to produce the perfect curriculum for those involved in the educational process. We know that no matter how hard we try to make the perfect curriculum, we will not succeed. Still, we know that we must try to be perfect. While realizing we will fall short of the ultimate goal, we will still progress.

What is an appropriate form of instruction for industrial arts during the remaining years of this century? We have options of having a very structured program of content and methodologies at one end of the continuum and programs which teach about industry and technology while emphasizing individual differences at the other. Should the construction of birdhouses, footstools, and pumphandle lamps be used as the method for teaching youngsters, or should students be prepared to understand technology and society with a more futuristic approach? There is no single correct response to the foregoing questions.

The results of past planning and the execution of these ideas are having an impact on today's happenings. It is common knowledge that what we plan and execute today will indeed affect tomorrow's society. Studies of past trends, called "trend extrapolations" (Bright, 1973), assist planners in industry, government, and education to better understand what has occurred in the past, how it may affect us today, and what we may expect in the future. Using the trend extrapolation process, I would like to review some selected events which have occurred since the beginning of this century in the field of industrial arts. This will be in an attempt to understand where we have been as a profession, how our past has affected us, and what we may expect in the future.

Shortly after the turn of this century, Charles Richards gave our profession its present name. A review of project work in the field during the early 1900's indicates that wood turning, clay modeling, mechanical drawing, and work with the forge were typical activities found in industrial arts education. There was pressure to change manual training to vocational education, to teach the applied arts, and to organize the classroom as a production factory in an attempt to get better educational results in the school shop.

Today, the field of industrial arts is contemplating a new name. "Industrial technology" or "industrial studies" could very well replace "industrial arts." Woodworking, clay modeling, mechanical drawing, and work with the forge are still activities found in industrial arts. The organization of the classroom into a producing factory is now considered an innovative teaching method in industrial arts, over half a century after it was first proposed as a form of instruction.

The popularity of industrial arts courses and work with one's hands has waned very little, if any, since it was introduced into the school curriculum. Perhaps one of the most consistent characteristics of our discipline is the working with one's hands. Other aspects of our profession such as the type of methodology used, the nature of the construction activities and the type of content to present have all been a matter of choice. This difference of opinion has caused confusion within the profession. Confusion and disagreement on issues are not new to industrial arts educators, for even in the 1920's it was reported that the nature of the subject matter known as industrial arts could not be agreed upon. This confusion still exists, for many of our educators at the secondary level still do not know the difference between the objectives of industrial arts and vocational education.

One important topic discussed in education in the 1920's was compulsory schooling. Compulsory attendance was enacted at that time. Today, there are those in our society considering an alternative to compulsory education which will allow education to take place on sites other than in the school building. This represents a reversal of the issue as viewed during the early years of the present century.

Frederick Bonser (1932), one of the great early leaders of the present century, became known for his work related to elementary school industrial arts activities. He advocated five objectives or purposes for industrial arts: health, economic, art or aesthetic, social and recreational content. Elements of Bonser's philosophy may still be found in many programs in our field today.

Another issue of these early times dealt with the implementation of vocational education at the junior high school level. Since many youngsters left school at an early age, vocational training was considered beneficial to young men. However, vocational education on a mass basis at the junior high school level proved unsuccessful then as well as with more recent programs.

The 1930's, the depression years, created a need to reexamine much of the curriculum and content for industrial arts. As a result of some of this reexamination, the Selvidge Plan was initiated. It was an attempt to perpetuate interest in industrial materials and processes. This particular approach to education called for a "plan of procedure" which has become a topic of many discussions concerning one's philosophy of teaching.

In 1939, William Warner sought to change the philosophy of industrial arts when he started the American Industrial Arts Association. Warner's efforts resulted in an organization advocating a slightly different philosophy than that of the American Vocational Association. This difference of perspective on philosophical issues still exists; both associations continue to promote their separate views of industrial arts content and methodology.

Prior to and during World War II, the pre-vocational nature of industrial arts was stressed. The war also caused a shortage of industrial arts teachers, still a problem in r ny geographic areas. (Zook, 1976). During the post-war years, Warner proposed a approach to industrial arts. He offered a program whose content was derived from a socio-economic analysis of technology. This approach was unique in that it was not based upon the job or trade analysis approach. The effects of both those who followed Warner's approach and those who followed the job or trade analysis approach (developed by Fryklund in 1965) can be found today.

Many different methodologies have been practiced by industrial arts educators. The 1950's were a time when the mass-production method became very prevalent — even though it was introduced many years before. New programs evolved in Minnesota and in Mary-

and where Maley (1952) introduced the research and experimentation method as a form of instruction in industrial arts. Maley's approach represented one of the first effective attempts in industrial arts to challenge academic courses in terms of content, methodology and teaching effectiveness.

Change in our field was most pronounced during the decade of the 1960's. Many new curricula were developed, field-tested and disseminated. The amount of change at this time was due to the amount of money available for curriculum development. Many institutes were conducted at colleges and universities throughout the United States which helped to identify and develop new leaders for the field. New programs such as the Industrial Arts Curriculum Project, the American Industry Project and many others evolved (Cochran, 1970). The decade of the sixties was truly a time of enormous growth and development for industrial arts.

As we review the past of industrial arts education, we find that many outstanding educators have left their mark on the field; that there have been numerous attempts to alter, up-grade, or change the field; and that financial support and the status of the nation were important. Even with this very sketchy perspective of the past, it is evident that many questions remain unanswered despite numerous attempts to provide solutions. For example, we still do not know what industrial arts should be or do. We have no consistent standards for industrial arts. Many in our profession confuse the objectives of industrial arts and vocational education. Should industrial arts content stress the contemporary technological society? Should we emphasize content, or should we emphasize the student? The list of questions relating to the profession could go on. It may be that at the turn of the century, we will still be debating the same questions. But, are we asking ourselves the right questions? Perhaps all of these statements are the very reason why our field has been able to grow and progress in the first place. Maybe, as a profession, we are better off not being able to reach a solution.

As educators attempting to plan the future of our profession, we have a difficult task ahead of us. While it is most helpful to use analogies and trend extrapolations to assist us in understanding our past and planning for the future, our society has been much slower moving and less sophisticated than anything we will experience in the future. According to Michael (1973), we are living in an age where we must learn to live with, and acknowledge, great uncertainty. We must embrace error. Our lives are constantly subjected to role stress, because many times we have to forego the satisfactions of a stable, on-the-job, social group relationship. But we still try to be pragmatic when we think of our future, a future loaded with uncertainties, projected to be fast-moving and nothing like we have ever experienced before.

The profession of industrial arts has not been known as being futurist oriented. Very little real planning for future events has ever taken place in our field. This is not inconsistent with other disciplines in education. Moreover, the lack of planning for the future is a common characteristic of Americans. To cite just one example, Dr. John McKetta (1971), the E. P. Schoch Professor of Chemical Engineering at the University of Houston and former chairman of the Advisory Committee on Energy to the Secretary of the Interior, described the status of the energy situation, in 1971. He likened it to being on your own 3-yard line with 10 seconds to go, and the score 36-0 against you. He also noted that the countries possessing the larger amount of oil supplies would gradually raise prices, and that there would be very little that we could do about it. This prediction does not seem so astounding today. In retrospect, the warning that Dr. McKetta verbalized about the future of the energy situation in our country was accurate — and unheeded. His information was available to anyone at the time and, like many futuristic predictions, this one eventually came true.

Here we are in an age of technological sophistication. Computers are the name of the game, and various forms of systems analysis are used to assist us in our work. However, we continue to stick to educational processes and procedures which were in use before the 1940's. Construction activities of the past have been a worthy and beneficial part of educational programs. They are still a vital part of industrial arts programs. Why, then, are we taking such a narrow perspective of the opportunities which our field can present to its students? Why are we, as educators, concerned with strategies of teaching which isolate specific materials when industrial products are constructed of so many different types of materials? Why do we concentrate on the teaching of specific printing techniques which are outdated, when there are so many additional forms of communications? Why are our major institutions producing so-called "highly qualified"

industrial arts teacher educators who in turn are hired to teach more 1940's woods, metals, and so forth? Few will argue that it is easier to do that which has been done in the past than to do some good hard thinking about what is and what should be. Industrial arts has offered much to students, but a gigantic challenge is ahead in terms of keeping its content updated and abreast of industry and technology. Members of our profession have not even begun to meet this challenge.

No doubt the future of industrial arts education will have many similarities to the past. The name "industrial arts" will probably be changed to some new name, although it is uncertain what that name will be. In the future, the field will experience many more new programs developed by concerned and competent educators. For example, new programs are being presented at this conference this very week. Financial support will play an important part in the development of industrial arts as we approach the year 2000. Many activities in our field will not change much before the year 2000. While change for change's sake is not good, if we are to mak progress, some change must occur. It is my prediction that progress will not be made many industrial arts classrooms during the next 20 years.

Although it is not necessary for the profession to answer many of the questions that have just been asked, we are obligated to make industrial arts teachers more effective. The industrial arts teacher, the teacher in the classroom at any level of education, is the most important aspect of the program. We may have beautiful facilities, an outstanding curriculum, happy and health students, but if we do not have a good teacher for those students, very little real learning will take place.

Industrial arts teachers, supervisors, and educators should start immediately to plan a future for our field by setting goals and planning to achieve those goals. Secondly, there is a need to implement a public relations program for better understanding of the objectives of industrial arts. This includes the school administrator, teachers, parents, and laymen. Finally, a fresh look should be taken at the type of teacher being developed by the training institutions.

As educators, we know that some people plan, others are planned upon. Some educators plan, others are planned upon. Should the future of industrial arts education be bumbled away by a group of educators who do not plan for the long range, do not know how to plan, and are afraid to talk about the need for future planning? Partly because of this lack of planning, we can easily be overtaken by other disciplines who have had the perception to see ahead as well as stake out the direction for their future. Due to the advanced forms of transportation and communication systems available today, the countries on our planet are being brought closer together. Therefore, as members of the industrial arts profession, we should be both assisting and learning from programs in other countries.

Failure to look at this country's current economic, political, and educational problems in terms of the next 10 to 30 years is costing us immeasurable dollars. Such lost opportunities are leading us toward philosophical, psychological, and sociological obsolescence. Is the nature of industrial arts content worthy and appropriate for a youngster in this so-called super-industrial age? Will the field of industrial arts survive because of its refusal to update educational practices? Alvin Toffler, the author of Future Shock (1970) and editor of Learning for Tomorrow (1974), advocates the development of an "anticipatory democracy." We as educators in the field of industrial arts education must begin to use an "anticipatory education." This is necessary in order to prepare our youngsters for a life characterized by high-speed technological and political change. We should be planning and anticipating for the coming years. Presently, very little planning is being done by anyone at any level of education in our field.

One of the major tasks when trying to produce change is proper education of those involved in the change process. The tradition associated with our field is one of the greatest hinderances to innovativeness. If content other than the traditional "how to use the tools and machines" approach is implemented by the industrial arts teacher, the parents, school principal and other personnel want to know why. Often there is resistance, for the course has suddenly become something different than that of the past. The general public is not concerned about whether the industrial arts teacher is interpreting industry or technology properly or whether the student is growing in the realm of human development. Therefore, a teacher of industrial arts can have his students produce a series of "canned projects" year after year and tell everyone that his program interprets the objectives of industrial arts. This teacher will not receive any flack from his prin-

cipal or parents, for that is what they expect.

This situation represents a major communications problem which the profession needs to act hpon now. The latest approaches and programs used in the profession should be well communicated to school personnel and the general public. A good public relations job which would educate the general public to expect more from an industrial arts program is needed. As a profession, we have by far the best means of motivating students to create, research, analyze, problem solve, question and learn about one's self and one's physical environment. However, we have not successfully educated the general public as to what to expect from industrial arts.

The professional requirements for becoming a teacher often serve as one of the main stumbling blocks to offering appropriate training programs. By the time that the student meets all of the state guidelines for a teaching certificate and the educational requirements of the college, there seems to be very little time left for classroom teaching experience. The majority of teacher education institutions training industrial arts teachers provide four years of classroom and laboratory experiences with a period of approximately two months of student teaching. Student teaching time, of course, varies from institution to institution. Sometimes colleges and universities tend to train individuals to be good students, not good teachers. A student may score high in technical and professional courses which will produce exeellent recommendations for teaching. Although this assists the student in becoming a good teacher, very little time is provided to practice the skills of guiding and directing students in a learning environment. This practice in the actual learning environment is perhaps of most importance to the prospective teacher. Ideally, we would like to have the future teacher out in the schools observing, teaching more, and just experiencing the environment of the teaching situation. For as Spillane and Levenson (1976) note:

> Teachers are not trained to deal with the immediate, pressing problems of the schools. None of them are certified to do anything about vandalism. None of them were taught in education courses anything about telling the difference between a bona fide book report writer and a pusher in the library.... But we need teachers who are trained to be part of a whole school. They can learn that only in halls and lunchrooms and bathrooms. (p. 488)

This is not to say that teacher training should be moved entirely to the public schools. Additional time in the public schools, however, will assist the prospective teacher in becoming more competent at directing learning. Realistically, this is a very expensive proposition for both the student and the cooperating institution. However, the expense should not prevent us from exploring new ways of gaining additional experience for our future teachers.

It has long been known that the student will follow much of his former teacher's attitudes, feelings, and practices. This is referred to as "teaching as you were taught." It is not necessarily the level of education that one receives which makes a good teacher. It is the teacher's understanding of human behavior and the content to be taught. If you agree that the majority of teachers eventually teach as they were taught, and if we teach specific content areas at the university level such as woods and metals, then we will more than likely see those content areas being taught in the secondary schools. It is necessary, therefore, to start teaching the future educator in such a manner that the type of teacher desired will evolve. If the profession desires to have specific subjects taught in the public school, than that is what should be taught at the colleges and universities. If, on the other hand, the college or university wants students to have an understanding of materials and processes at the secondary level, then that is what should be taught. We cannot teach specific materials and in turn expect general concepts to be adopted in the field. This is done, though, because teacher educators are afraid that the public schools are not yet ready to divorce themselves from the traditional approaches. Also, an effective public relations job has not yet been undertaken by the profession to properly articulate the trends and need for the general conceptional approaches. Many in our profession are not aware of a trend toward general conceptional areas such as materials, processes and communications. As a result, change in our field will be very slow; we will continually lag in implementing contemporary approaches to teaching industry and technology. Our profession will continue to teach technical subjects using a narrow perspective. Compared to the fast-moving society of today, our profession is moving at a snail's pace.

The educator in the classroom today is committed to a variety of learning strategies,

the open classroom, individualized learning and multi-age grouping, among others. These strategies have a common concern of creating new effective learning experiences. New teaching methods are developing which need to be assimilated into the profession. The use of video productions is becoming more commonplace. Although the computer has not yet found its way into instruction in many schools, the advent of the computer into the regular classroom setting seems to be only a matter of time. Therefore, it would be beneficial for our profession to have instructional courses which show proper use of these devices. Media definitely will not take the place of the teacher, but they will be of great assistance to the teacher who knows how to use them. Despite these facts, very few colleges and universities have courses in basic computer technology as a requirement for future or practicing industrial arts teachers. Our profession should not be lagging in providing these experiences to its teachers. If you believe that computers will not be used in your school at any time in the near future, you are kidding yourself. The actual computer for your school may be located in Los Angeles, Chicago, or New York. All that you need is a telephone to dial into the system.

While speaking on the topic of media used in our field, it seems appropriate to analyze the type of media currently available and being produced for the industrial arts profession. Video cassettes and similar teaching aids can be purchased commercially for technical courses. Most of the materials produced for the market are technically-oriented materials. What the industrial arts profession needs are more materials oriented toward industrial type situations. There is a great need for a variety of short programs explaining the basics of marketing, stock sales, routing schedules for products, plus the many other procedures practiced in industry. Media such as this would help bring industrial arts students and teachers alike closer to interpreting industry and the use of technology.

We, as educators in the field of industrial arts, have had a rich heritage despite the lack of planning. The future of our profession will evolve as we identify strategies and goals which our field should strive to attain. Hopefully, we will develop both short and long-range goals. As an educator in the field, do you care about the future of industrial arts? If so, start planning the direction in which your program should go. Research the latest programs and happenings and articulate your program to others, both in and out of the profession. You will be doing your profession a favor. But most of all, your students will be far better off because of your efforts.

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Materials Technology: 200 Years and the Future

James N. Yadon and Ralph V. Steeb

Materials technology is a very important part of the lives of all of us today. The energy crisis and the materials shortage are front runners on today's headlines. I would like to spend a short time at the beginning of this presentation to explain why these two things are virtually inseparable in their importance to the world. Technology has been defined as the link which connects science and invention with the wants and needs of man. It covers both materials and energy, both of which are necessary for the wants and needs of man today.

There are three major similarities between the energy and materials crises: (1) Materials are made of that substance called matter which is equated to energy in a solid state. Changing wood into smoke and heat is, on a broad level, not unlike changing heavy hydrogen or deuterium into helium and energy. (2) There are great quantities of materials on earth and throughout the universe. The same is true for energy. The problem, however, is that the most useful forms of both energy and materials are limited in their accessibility and utilization. (3) Materials and energies are both being consumed at a rate approximating a geometric proportion. The easily accessible, high quality materials and energies and their sources are already nearly gone. The need for materials and energy increases at a rate far greater than the frightening growth of the earth's population.

We, as educators, must address ourselves to the specific problems we face today, and there are many. Here are just a few:

Energy: The rate of consumption increases astronomically while the major sources are being consumed at a frightening rate.

Population: The dire predictions of the consequences of the geometric growth of the world's people, while not yet true, are beginning to affect the lives of all of us.

Environment: The waste energy and materials are being concentrated in even greater quantities throughout the world. We do not yet know what the long time effects will be. We do have some very good evidence that it may well be at least as serious a problem as many are predicting.

Food: The world food problem is now approaching the crisis point. We in the United States are suffering little of the real result of the problem. Our cost of food has not yet risen to any alarming heights. To some extent, the United States has profitted by being in a position to well surplus food stuffs. But this food shortage is much more real to the rest of the world and could easily become the most serious problem we have in the shortest length of time.

Materials: The least talked of problem and to a larger extent one that will affect the average person in a more subtle way is that of materials. In a prosperous country such as ours and with the abundance of material things we have, it is hard to realize that the resources from which these material things come is limited and that we are fast coming to that limit. We import large quantities of materials into the United States to produce energy and to supply the raw materials for the world's largest industrial producers.

There are certainly other problems that could be added to this list. Some here could probably add the problem of declining public support and emphasis by the local, state and national government regarding education (especially since the drastic reduction in educational demands and enrollments predicted by so many have certainly not come true). Why then, on the subject of materials technology, bring in these other areas of concern? Because there is no way they can be separated. The interrelatedness of each of the areas mentioned prevents one from isolating any problem in one area and trying to solve it apart from relating it to the whole of the combined areas. As I have already stated, materials and energy share the same resources. Every area is affected by every other area. The increased demand for energy depends upon the consumption of materials. The prime source of energy is fossil fuels. Fossil fuels are also the prime source of materials for the polymeric and petrochemical industries. So with the decrease in this resource of fuel comes a decline in the materials it provides. Educational levies are increasing rapidly in the greater part of the world, especially in the developing nations. Expectations and demands for a better life, which depend upon greater production of energy and materials, increase with education. Mehrens, in his paper on "New Dimen-

sions in Space Age Education" says that technological effort has become interwoven with activities of government, industry, labor and education.

The cycle increases in dependence and intensity. The solution may come through knowledge if there is to be a solution. We in education must do all that we can to contribute to the solution. We cannot in good conscience be contributors to the problem. In the same paper as mentioned before, Mehrens also says that consequently, within the profession of industrial arts we must not stand still; there is considerable delay in the appearance of new technical knowledge in textbooks in the industrial arts, and an even greater lag before it appears in the teacher-training process.

Materials have been an integral part of man's environment from the beginning. Man has depended on materials for food, clothing, and shelter. The earliest records that man leaves are only those of materials. Early man used implements of stone, such as projectile points, scrapers, grinders and other small hand tools. He used clay to make simple forms of pottery such as bowls, ovens and so forth. The common metallic materials used today were discovered later by man as civilizations grew. His access to material resources increased. Copper and bronze were being used over 5,000 years ago. Around 1200 B.C., the discovery of iron had a great effect on the life of near eastern peoples. Implements used in war, such as swords and daggers, were then so much stronger than they had been previously. Egypt, which had risen to become a great empire only a few hundred years earlier, was doomed to fall partly because of its lack of iron resources. She was still living in the bronze age while the rest of the world around it had progressed to the iron age. The gap between Egypt and her neighbors became bigger and bigger until they finally overran her. The lack of an important material had severely damaged her world position.

Although materials were very important to early man, and even though his limited and unscientific knowledge of his world led him to the use of materials, most of the time it was by accident. The slow empirical processes which increased the usefulness of materials to man over these several thousand years were little related to education and specifically to science. The theories and explanations of materials were left to the philosopher while the potters and metal workers developed materials by trial and error. There were no understandings of the processes involved.

Perhaps it is a coincidence that the first real efforts to utilize education, science and materials began about two hundred years ago. This is the bicentennial year and the theme of this conference is supposed to reflect this time span. Harrison Brown, professor of Geochemistry and professor of Science and Government at the California Institute of Technology says that the actual level of science and technology in the United States was very low two hundred years ago and that when the land-grant colleges were created, there was almost an explosion in scientific research which has had a profound effect on our entire economy. This effect is destined to last for a long time.

If there was one aspect of life today that our Founding Fathers could not have dreamed of, it must be the fruits of science and technology. Lawrence A. Cremin, president of Teacher's College, Columbia University has said that the most revolutionary aspect of this society is what it has done in education. It has been mainly through this rise in education in our country that we have the fruits of technology and science to enjoy.

Harold E. Mehrens is again quoted as saying that in the 1700's England became supreme with only three million people on a small island, because it had some natural resources and knew how to use them. Before the invention of the steam engine, man had not known how to harness power even if it were available to him. After the invention of the steam engine, factories sprang up and the Industrial Revolution had begun. The Industrial Revolution depended in large measure upon the development of new materials and better methods of processing these materials. The metallurgist can point with pride to the great progress made in the ferro magnetic materials technology between 1750 and 1850.

The continual and accelerated need for more and better materials during the 19th century brought the increased use of science and education to discover new materials, solve problems and to accumulate and disseminate this knowledge to the consumer.

It was during this time that a Swedish metallurgist named Rinman observed that carbon was the chief difference between Damascus steel and cast iron. This observation was studied by the great chemist Bergman whose resulting theory of the role of carbon was essentially correct. Three French scientists restated the theory and provided the basis for the development of high grade steel without the mystery which had clouded the

levelopment and use for so many years.

The 19th century provided the development of many new materials and processes. In the field of ferrous metals, the outstanding achievement was that of producing molten low carbon "steel." Bessemer developed the well known Bessemer converter and Siemens the open hearth furnace. It is notable that the open hearth process was developed on the basis of science and was one of the few developments up to that time that was not empirical in nature.

Another example is stated by T. L. Birrell, president of the Plastics Institute: "The plastics industry as we know it today has developed during the past 25 years but prior to this there was a long prelude beginning with the birth of celluloid in 1862."

The first three quarters of a century is largely a story of the individual effort and achievement. The struggle by dedicated individuals with real faith in their mission was the key to overcoming the many struggles which provided the basis for much of the materials used in the plastics industry today. "A hard beginning maketh a good ending." A French minister of education said some 80 years ago that it is sometimes necessary to separate practice and theory because life is short but they should always be combined when possible because life is complex.

The late 1800's and early 1900's produced a rather astounding development of materials, materials science and materials technology. Newer materials, higher quality and more exact control of the properties were paralleled if not surpassed by the application of these materials into a myriad of industrial processes. Perhaps no single greater application of these materials was to have the effect that the first manned flight by Orville and Wilbur Wright in 1902 did.

The materials and poser for the first flight were available but the need was for a satisfactory design. The development of the airplane quickly brought about the need for better materials for air frames and power plants. The materials development kept pace with the available energy sources for aircraft up to the end of World War II. It was at this point that the materials development fell quickly behind. The jet engines made available a useable source of power far beyond the limitations of the materials available.

To cite an example, look at the first American built operational jet fighter, the Bell "Shooting Star" P-80. This was indeed a fine aircraft and with its 10,000-dollar paint job could almost attain sonic speeds. The 100,000-dollar engine, made of the best available materials for strength, heat and corrosion resistance was used. The engine was so designed that it could be removed and replaced in only thirty minutes. This was necessary because the engine lasted for only 10 hours of flight. It is interesting to note that few of the first engines actually lasted the full 10 hours of life expectancy. The engines needed new and better materials. The empirical experiments coupled with the rapidly developing scientific knowledge of the atomical structure of materials produced materials that within five years could operate hundreds of hours with little wear.

The "progressive march of science" which Thomas Jefferson talked of is very much evident today. In the 75 years since man's first flight, he has developed and utilized materials to make manned flights to the surface of the moon. In July of this year, the United States will soft land the first unmanned vehicle on the surface of Mars. Supersonic aircraft are common today and hypersonic aircraft are within a few years of being commonplace.

The period from 1900 to 1945 could be called many things, but one which stands out quite prominently is that it was a period of great chemical growth. Perhaps it could rightly be called the chemical age. But this growth in chemicals has not stopped. It has rather increased in tempo and led into growth in other areas.

Today physics is the scientific metallurgy. Physics replaced chemistry with the development of the X-ray diffraction and the electron microscope. The empirical method of studying materials has given way to scientific investigation. There is, however, a significant difference between the past and present methodology of the study and utilization of materials. The past was fractured into many diverse areas of materials and sciences.

Today, the materials scientists, materials engineers and materials technologists are concerned with the total technology of materials.

Metals are alloyed not only with other metals, but with a wide variety of nonmetals to produce materials with specific or special properties not possible without drawing upon the complete range of elements. Composite materials are finding new uses as the desired special qualities of one material are retained and incorporated into another material with some other specific quality of property.

While fiberglass is still the main composite material, other materials such as boron filaments, silicon carbide and graphite are being tested.

Refractory materials are being studied but not independently. The trend is to utilize the inherent properties and knowledge available of all materials to produce the exact material needed.

The integration of the concepts of physics, chemistry, metallurgy and mechanics, which considers the properties of materials from atomistic, electronic and structural relationships rather than from arbitrary groupings of chance, is looked upon by many as one of the most important developments in the history of materials.

This development has spa ed the present trend toward such courses as Materials Engineering, Materials Science, Materials Technology and Materials and Processes which are prevalent in today's educational institutions both at the secondary and high education levels.

Education is the necessary part of the success of building of national economies of solving man's problems. Victor Wegotsky states in his introduction to "Materials in Space Technology" that one of the biggest developments has been the emergence of the materials system and the welding together of the linkage among the materials scientists, the designers and the fabricators. This recent development in education has produced materials with amazing properties and processes to meet the needs of the technological world we life in.

It is with this background that we now look toward the future and try to discern some of the possible developments.

A. B. Wilder as quoted in the preface to "A Hundred Years of Metallurgy" says:

> We study the past
> because it is a guide to the present
> and a promise for the future.
> The struggle for a better world is strengthened
> by the hopes, ambitions, and deeds
> of those who were before us.
> As we look backwards
> our attention is directed forward.

One thing is for sure. Materials technology will not remain static. If there is one thing we can learn from the past, it is that predictions are more often in error not because they are made in too short a time reference, but because they prescribe time and knowledge developments at a pace far too slow.

Let me give the following example. In 1946, at the conclusion of World War II, a national conference was called by those involved in the aircraft and flight industry. Government, civilian, military and industry were all represented. Their published conclusions contained these predictions in paraphrase: Jet aircraft will be used as fighter aircraft and possibly for some types of bombers; military transports are a distant possibility but not a likely development; the use of civilian jet passenger planes is not considered a possibility for the foreseeable future. Thirty years have passed and now we have the C-5A, 747 and the Concord. One of the primary reasons for these seemingly impossibilities was the rapid development of materials technology.

What will the materials of tomorrow be? Steel has already been improved in such ways with the addition of chromium so that our kitchen knives are now rustproof and stainless. As one of the standards of materials technology, it has already been developed with a tensile strength of 500,000 psi. Steel of tomorrow will certainly reach one million psi. (Recent developments have been published which indicate this prediction may have already been achieved in laboratory conditions.) Steel of tomorrow will almost certainly be manufactured in space. Foamed steel, steel with uniformly dispersed alloying elements, steel with uniform grain structure and steel with little or no atomic dislocations are but a few of the many possibilities.

Aluminum, first formed into a metallic state within the past two hundred years, and the workhorse of the past and present space age will continue to be developed. New alloys at one time considered outside the realm of possibility will be developed to extend the use of earth's most plentiful metallic substance.

Copper and copper alloys will be used along with many of the well known materials of the past such as brass, bronze and nickel alloys. The new clad materials will be

greatly expanded to provide many structural applications with electrical, corrosive and physical properties.

New materials not common to industry will become increasingly used in industry. Beryllium and titanium, developed within the past thirty years, will find much more common usage.

Refractory materials, especially those metallic materials such as molybdenum and tungsten, and the recently isolated elements of columbium and tandalum will continue to be developed to meet the need for higher and higher thermal and corrosive environments.

Glass, a very common material, will become far more useful as such alloys or compounds as ultralow-expansion titanium silicates and cerametals are developed. Structural glass and silicates will almost have to be developed to replace organic materials now being used.

Manufacturing in space, already begun on the sky lab missions, will be increased greatly by the early 1980's. The space shuttle will make possible the ferrying into space and bring back much larger quantities of materials and equipment needed for the many scientific investigations to develop technology.

The implications and expectations of "zero" gravity hard vacuum processing of materials are truly mindboggling.

Levitation melting, the process of suspending a material in a magnetic field and melting and resolidifying the material, is possible in only minute quantities here on earth. In space, large quantities could be processed in this manner. The added attraction of "zero" gravity provides almost perfect spheres upon resolidification not possible here on earth. A drop of water contracts from an irregular shape into a perfect sphere with a surface velocity of 150 mph. In the case of iron, the velocity is near that of sound. The use of molecular forces for processing materials in such a manner could produce accuracy within angstrom units (100 millionth of a centimeter).

Soviet scientists reported in 1973 the production of metallic hydrogen. Such a material, if stabilized could revolutionize the transmission of electrical energy since it is theorized that it would be super conducting. Fabrication of super light structures would be possible also.

The use of environmental and energy fields to produce materials not even dreamed of is very likely within the next 25 years. Magnetohydrodynamics has already produced temperatures of 100 million degrees Fahrenheit. Pressures 10 million times greater than our atmosphere are expected.

The ability to form materials at the atomic and sub atomic levels is well within the realm of possibility. Such materials could well revolutionize the present industrial and technical world at least as much or more than iron did the ancient world of the bronze age.

And what of tomorrow's education? Will we still be using the same materials and methods we use today?

Perhaps we, as educators, should look carefully at the developments now shaping our world and the expected developments of the near future as well.

The challenge we face is not just to keep abreast of technology, but the infinitely harder task of teaching this technology to those who must follow.

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Professional I.A. Teacher

Freedom, Professionalism and Our National Heritage

Donald Maley

It is significant that this "Crossroads '76" conference of the American Industrial Arts Association is being held on the eve of this Nation's two hundredth birthday. And, perhaps as we join wi. nillions of people across this great nation in the Bicentennial Celebration, we will ren our perspectives about the basic and fundamental principles that were the seeds of the national harvest that blossomed forth on that fourth day of July 1776. Foremost among those principles that undergirded the fabric of thought and deed on that historic day was that of "Freedom". Here some two centuries later the Industrial Arts Profession has appropriately set about to celebrate our Nation's birthday as a way of telling ourselves, our neighbors, and the whole world that we have endured two hundred years. But it is the ideal of freedom that merits our celebration, and how newer and broader dimensions of human freedom have evolved through the years. Yes, as the acorns give birth to mighty oaks that grow bigger and stronger with the years, so too have the seeds of freedom of the New England patriots and Virginia planters provided us with a growth and heritage that merits a birthday not just in 1976, but in every day and year to come.

Think if you will if this nation some 200 years ago had lost the vision of humanitarianism, individual freedom, justice and the principles of democratic government; and think if you will what the world might have been like today if, without the above vision and spirit of mind, this nation had become a dictatorship or some other form of authoritarian state.

There is a wonderful old American standard that contains these words:

> Oh beautiful for spacious skies,
> For amber waves of grain,
> For purple mountain majesties —
> Above the fruited plain!
> America! America!
> God shed His grace on thee, . . .

Please be reminded my friends and esteemed colleagues, that the gifts were not just mountains of majesty, waves of golden grain or endless fruited plain.

The greatest of all gifts was that undying spirit of our founders that we would start with freedom and we would use our great natural resources and human talent to develop a nation that would one day be copied and depended upon so heavily by nearly every nation and governmental unit in the world. Yes, we have spread our wealth, our generosity, our resources, our technology, our manpower and our idealism. But we also have spread our spirit of freedom and our context of democracy to all corners of the globe. And, it is freedom that I want to dwell upon in the next few minutes. Freedom is not just a matter of being able to vote on election day, or the rights of a free press, although they are important. Freedom must extend into every nook and cranny of our daily existence, just as the nervous system in our bodies extends to every dimension and every extremity of our physical being.

As a teacher, you too must be concerned with freedom, for it is only by the exercise of freedom that the teaching profession can exist and ever hope to carry out its awesome task that was laid out for it some two hundred years ago.

The publication, Goals for Americans, contains in its introduction the following statement: "The paramount goal of the United States was set forth long ago. It is to guard the rights of the individual to ensure his development, and to enlarge his opportunity." (4, p. 1)

As contemporary as these ideals may seem, they can be found set forth in the Declaration of Independence as adopted by the Continental Congress on July 4, 1776.

John W. Gardner in his discussion of "National Goals in Education" has stated:

> . . . Our deepest convictions impel us to foster individual fulfillment. We wish each one to achieve the promise that is in him. We wish each one to be worthy of a free society, and capable of strengthening a free society. (4, p. 81)
>
> Education is essential not only to individual fulfillment but to the vitality of our national life.

This is an enormous task and it is one that will require the best from our educational agencies no matter where they are found.

The concept of "fulfillment" is based upon the recognition of — and attention to — the important idea of "individuality" in its many and diverse forms.

The thesis of my discussion at this point is that the teacher's fulfillment is dependent upon the freedom that he or she is willing and able to exercise in the pursuit of the tasks of a professional educator. And, likewise, the mere attempt at achieving the previously stated goal set forth in the Declaration of Independence, that of guarding the right of each individual to pursue fulfillment and to enlarge his opportunity, will require levels and degrees of freedom on the part of the teacher that will permit the exercise of professional judgment, as well as a diversity of programs, experiences and procedures to cope with the educational needs of this nation's people young and old.

> The history of American education is the long, turbulent record of a nation that wasn't afraid to risk failure or trouble or confusion in pursuit of a goal that at first seemed widely impractical: to give every American child a chance to develop to the limit of his ability. It is still one of the most radical ideas in human history, yet it grew out of the American soil as naturally as wheat or corn. (2, p. 67)

I ask that you look upon your freedom as a teacher as an opportunity — an opportunity to develop the potential for teaching excellence that may exist within each of you. Just as we must recognize and deal with the great multitude of differences and factors of

individuality that exists within our students. Each teacher in his or her own right is a composite of individuality consisting of strengths and weaknesses, as well as emotional, intellectual and philosophical differences.

There is no single mold for casting our teachers just as there is no single teaching style, process, or program that is suited to all teachers or students.

We have not generated teachers in many of our institutions. We have generated robots who want to be turned on or off by principals, supervisors, courses of study or programs that permit no thinking or judgment.

Some while ago, a publisher asked me to review a manuscript from a professor in a certain teacher education institution. This manuscript contained a teacher's manual as well as a student's manual. The teacher's manual and supporting materials contained precise questions to be asked of the students as if the teacher could not think for him or herself. The teacher's materials contained specific directions for doing just about everything in the conduct of the program. It contained precise listings of supplies and materials to be used so one could buy such items in kits for each student or experience. This is surely one way to build rigidity into a program and decrease the freedom of both teacher and student. The student's manual was just as disrespectful in its dealing with the learner's abilities, for it even listed questions that they (the students) should ask the teacher. Think if you will, what kind of a nation we will build if our teachers are content to be slaves to a prescriptive program that defines their every action, and far worse, think of the kind of a nation we will build if we tell the learner the precise questions he/she should ask.

Yet my friends, there are teachers and administrators of teachers who seem to want just that kind of program. As I search for the logic behind such actions I am told that we need programs that are teacher proof. Elliot W. Eisner, in his text Confronting Curriculum Reform, addresses this "teacher proof" logic head on in the following comment:

> If one thing has been learned during the past fifteen years, it is that the so-called ideal of "teacher-proof" curriculum is a mirage subscribed to by those who have little contact with the subtleties of the classroom. (1, p. 7.)

The free and open spirit of a freedom-loving people would soon be lost if such naive and thoughtless concoctions of professional inferiority were permitted to grow and prosper. However, I am fully confident the patrons of our schools in the exercise of their freedom will smoke out this insidious cancer that has found its way into our educational practices.

However, it is the profession that should be the watchdog of its operations, and up to this point it has seen fit to look the other way. If we depend upon the patrons of our schools to do the monitoring and dealing with such programmatical elements of teacher function the consequences might put the profession in an entirely different position than it would want.

The mechanistic character of certain educational programs currently in use do not encourage the concept of teacher individuality nor that of teacher freedom. In its place such programs tend to promote uniformity and conformance. As teachers we need to read and re-read that great classic on education that was written by Harold Benjamin titled, The Cultivation of Idiosyncracy. For, my friends, it is not through the attempt at uniformity of conformity that excellence in teaching for each of us will be achieved. Your principal assets in your quest for teaching excellence, as well as excellence in your contribution to the profession, will be found in your idiosyncracies and I ask you to exploit them just as a great baseball pitcher exploits his unique pitches to deal with the batters he faces.

Freedom for the teacher in this society is not luxury to enjoy or to relish for its own sake. And, furthermore, freedom for the teacher does not mean that you and I can do as we darned well please. All freedom exists within boundaries, and certainly the freedom of the teacher is no exception. The great and grave responsibility that is yours as a teacher brings with it boundaries and restraints to freedom that take on many and diverse forms such as — professional ethics, confidentiality of information, the requirement of dependability, ethical behavior and the pursuit of societal established goals.

But the freedom to make decisions regarding the instructional needs of the learner, and the freedom to make decisions about methods, strategies, rate, pace and variations in content commensurate with the needs of the learner are important professional freedoms that should rest with the teacher. And yet we find hosts of teachers who chose not

to accept these freedoms and are willing to follow prepackaged educational strategies and dictum in which they have not had one iota of input or any form of decisionmaking.

> One of the clearest dangers in modern society is that men and women will lose the experience of participating in meaningful decisions concerning their own life and work, that they will become cogs in the machine because they feel like cogs in the machine. All too often today they are inert components of the group, not participating in any significant way but simply being carried along like grains of sand in a bucket. (3, p. 59)

Freedom is a requirement that must be felt and exercised in the executiion of one's professional responsibilities as a teacher in a free society where individual fulfillment is a goal of the educational process. Rigid, dictated and lock-step-prescribed programs cannot exist where teachers understand and respect their freedom just as those New England patriots understood and respected their freedom against tyranny some two hundred years ago.

As teachers and leaders in the industrial arts profession, I hope and pray that you will be filled with the vision, the vigor and the enthusiasm — that there are things you want to do; — that there are ideas you want to test and apply, — and that there are principles and procedures that you want to challenge and evaluate in the cauldron of education for a freedom-loving people. And likewise I hope and pray there is not one among you who would give up your opportunity for freedom as a professional for something that is easier, cut and dried, and routinized by the clock and day.

> Much education today is monumentally ineffective. All too often we are giving young people cut flowers when we should be teaching them to grow their own plants. We are stuffing their heads with the products of earlier innovation rather than teaching them how to innovate. We think of the mind as a storehouse to be filled rather than as an instrument to be used. (2, p. 68)

I also want to remind you that freedom never walks alone in any effective society, social order or governmental unit. It has a constant companion that each of us must adopt if we are to share the privilege of freedom in any way that freedom will prosper and endure. That persistent companion of freedom is responsibility — responsibility to carry your share of the burden of government, of the profession, of the functioning of the home, school, or society wherein you enjoy the fruits of a free person.

> ...In short, it is necessary to examine the capacity of the individual to accept the responsibility of freedom and the conditions under which he will sacrifice his freedom to gain other objectives.... (3, p. 90)

If we ignore the responsibilities that must be shared in a free society, we will surely lose our freedom, for freedom without responsibility soon degenerates into anarchy. This is a point that each of us must understand; it is an issue that will demand more and more consideration as we double our population, as we move into an urban society, and as the impact of our individual actions have an influence on increasing numbers of people. The freedoms and accompanying responsibilities of Robinson Caruso on that lonely island were of one dimension, but those of us who live in Twentieth Century America have an entirely different dimension of involvement with both freedom and responsibility.

It is important that the teacher see his/her acceptance of freedom in light of the much wider sphere of human interaction that extends to each and every student and to the limits of their bounds of activity. The ingredients of purpose and commitment to the ideals of personal freedom interacting with the complex goals of the larger affected dimension of lives and their fulfillment become the substance of meaning for the teacher.

> ...But each kind of meaning implies a relationship between the person and some larger system of ideas or values, a relationship involving obligations as well as rewards. In the individual life, meaning, purpose and commitment are inseparable. When a man succeeds in the search for identity he has found the answer not only to the question "Who am I?" but to a lot of other questions too: "What must I live up to? What are my obligations? To what must I commit myself? (3, p. 103)

And my young friends of The American Industrial Arts Association I hope that you too have taken a page out of the books of our founding fathers. I hope that as you teach you will relish the freedom that a great teacher needs and desires in order to cope with the many and diverse challenges of education in a complex, dynamic, and free society.

You have learned of the great variations that exist among individuals with respect to their giftedness, interests, ambitions, motivations, physical and mental abilities, backgrounds, securities, insecurities and a host of other factors that contribute to making up each person. And for those of you who have not taught in our public schools, you will come face-to-face with that reality when you do go out to teach. It is at that time when the sincere and competent professional teacher will realize the fallability of highly prescriptive programs for all students in a given class or grade level.

It is at this point where you will need the freedom to be yourself – the freedom to design, to contrive, and to innovate with instructional procedures, – and the freedom to deal with the content so that maximum individual development of each student may be attempted.

If the teacher is willing to give up the freedom of decisionmaking in his conduct of the teaching process, he must also be cognizant of what he accepts in its place. Otherwise, he might find himself in the same position of the hordes that enslaved themselves to the dictates of Hitler, Mussolini or Stalin.

As a public school educator you must examine the value and effectiveness of the alternative to professional freedom with respect to accomplishing the mission of public education in these United States. You must examine the alternative in terms of its consistency with the best that is known in the areas of learning theory and pedagogical practice. You must examine the alternative with respect to its recognition of – and attention to – the concepts of individual differences and the pursuit of educational practices that strengthen such individuality. You must above all examine the alternative to freedom on the part of the teacher, with respect to what vested interests are served by the alternative.

The issue of freedom takes on two important dimensions. There is the freedom that the teacher takes upon him/her-self whether that be one of an analytical-creative problem-solving individual, or that of a conformist to a lock-step program. The other important dimension goes beyond the self and extends to his or her responsibility to the students and the society in which the teacher functions.

> A meaningful relationship between the self and values that lie beyond the self is not incompatible with individual freedom. On the contrary, it is an essential ingredient of the inner strength that must characterize the free man. The man who has established emotional, moral and spiritual ties beyond the self gains the strength needed to endure the rigors of freedom.... (3, p. 93)

Thus my friends, in examining the logic behind one's willingness to give up the freedom of professional initiative, decisionmaking, ordering, and structuring in favor of that which is easier (that which requires a minimum of planning, ordering, or structuring) it is quite apparent that the "self" is what is being served and that beyond the self may well be neglected.

Also, it is possible that a much closer examination must be made of our teacher education processes as well as of those who are permitted to enter into the profession in a free society.

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New Directions from Old—Evaluation

Wayne Nelsen

Evaluation has been a topic which has had its share of attention in the past, but one which is now becoming more important than ever. In this day of criteria referenced education, CBTE and educational accountability, it is imperative that educators be able to determine progress towards a given set of objectives. The following statements as to the future direction of evaluation by Dr. Kendall N. Starkweather of the University of Maryland are most supportive of the need for a well developed evaluation program.

> Teachers will be accountable and measured by their product student outcomes.
>
> Evaluation models will be based upon a more analytical individualized behavioral change construct with emphasis on personal goal attainment.
>
> The affective domain and values and value systems will become more important.

If one accepts these directions for evaluation, then indeed there is a very pressing need for an intensive examination of old and new evaluation techniques. It is towards this end that this presentation has been prepared. There are two sections to the presentation. The first section deals with the use of a system of specifications for the determination of evaluation techniques. The second section deals with some possible variations on accepted evaluation techniques.

SECTION I — A SYSTEMS APPROACH TO TECHNIQUE SELECTION

The use of a table of specifications is not at all new or different. What is somewhat innovative about this application is the way in which a system is being used. In the past when a table of specifications had been used, its purpose was to ensure that the number and distribution of questions in a given evaluation technique closely approximated the instruction which preceded it. In the case of this system, instructional emphasis is not being directly compared or linked to the evaluation techniques, but rather to the relative priority of objectives, broken down into three domains. There are several advantages to this approach. The first is that the selection of evaluation techniques will be removed from the gut reaction level to a more educationally sound process. This is not to say that if there is a valid reason for not using a technique, that it must be used, but rather that some of the techniques which until now have been under-utilized may now be considered. It is important that the distribution of evaluation techniques parallel the objectives of the course.

In order to use the system as presented it is a two step process. First, the objectives of the course must be listed in terms of their domains, and then they must be totaled to see that they are ranked in order of priority. The domains, cognitive, psychomotor and affective, must be broken down into four categories or levels. It is important that the cognitive domain be broken down into the high and low levels of learning.

The next step in the process is to take the evaluation techniques available and determine the domains which each evaluates.

Having completed the preceding steps, one can go through the rated listing of evaluation techniques and using the priority which was developed from the analysis of objectives, select the techniques which best fits his priority. In terms of the theoretical, all one has to do at this point is administer the various techniques, weighing them equally, and the evaluation program will be directly related to and reflective of the objectives which were established. Unfortunately though, one must modify the evaluation techniques selected, using factors which affect the individual situation. Specifically, the use of the individual project in a school system which cannot afford the cost, must be excluded. Another such example would be teaching in a subject area which does not have a standardized test prepared. If this is the case then it would be most impractical to use this technique. One may not have the room, or small enough class to use a practical test so that the appropriate shifts in evaluation techniques must also be made. Remember it is important to have some familiar, as well as some new, techniques in any evaluation program.

SECTION II – VARIATIONS ON ACCEPTED EVALUATION TECHNIQUES

The final section of this paper is possibly the most important. It deals with two specific ways of evaluating progress or development in the affective domain. Earlier in the paper the industrial arts interaction analysis was alluded to, now it is time to deal with it in some depth. Its purpose at the time of inception was to evaluate on an objective scale the performance of the student teachers. The idea was that by requiring snap decisions using exacting classifications which were very simplistic, one could get an honest picture of what was going on in the classroom.

The big problem with this system being used in the evaluation of students is that it was developed for use on a more or less one to one level. In order to circumvent this, it is necessary to concentrate on only four or less students at a given time. Since the number of responses will be greatly increased due to the extended period of time over which these observations may take place, this is not a problem. The one thing which must be kept is the use of uniform classifications or descriptions of the activity taking place. Another factor which must be respected is that the number of observations of the individual must be kept approximately the same. The rotation of the day upon which the observations are taken is also important so that the student who would otherwise be observed every Friday will not be. The time within the class period must also rotate. It is possible that a student returning from a sports activity, who was evaluated at the beginning of the class, may in fact get an extremely poor rating.

The thing that remains after numerous observations have been made is the quantification of the data. It is of no use, unless it somehow fits into the total evaluation program. One way of quantifying the data is to assign each of the descriptors a numeric value from negative 2 to positive 2. By doing this, two things have been accomplished. The data is now on a five point scale and zero, which indicates acceptable but not out of the ordinary behavior, can easily be converted to a C, which by definition in most systems should stand for average. By using this system there are two options open to the teacher. The first being that of establishing minimum levels of expectations, in terms of the overall ratings, which is tantamount to criterion referenced evaluation; and the second option is to compare the ratings of all the individuals in the class which would give a norm referenced evaluation.

There is the additional possibility of using this instrument for peer evaluation. If all the considerations previously presented about peer evaluation are taken into account, one could give this form to any number of students and have them make the snap decisions using only actual observations which fit the pattern of the form. In other words by forcing the decision in a short period of time and making the decision a descriptive one rather than a value one the peer evaluation may be more useful than it would be in other systems. The individual making these observations could be just one student evaluating or observing another or a group. This device could have some potential in terms of the group project where the leader of the group would have a positive way of reporting the activities of its members and the members of reporting on the activity of the leader.

This form of recording and processing information about the students activities will at first require a good deal of work and initiative on the part of the individual teacher, but it has as its reward a very positive way of using observations in evaluation. The date, times and actual facts of the student activities will be much appreciated by the parent when he or she inquires about his child. In the past one very bad day, or couple of days, has meant that the student is 'marked' for the rest of the semester. With this system attendance is a factor as well as the total pattern of behavior. There is always the option of assigning a zero to a day absent, assigning a negative mark or of redoing the observation. At the teacher's discretion, of course, these decisions are made and adhered to for the entire repeating time.

The last thought or idea to be presented in this paper is the idea of using forced preference test, possibly similar to the Edwards, to determine if in fact there has been a change in the attitude of the student. The areas that can be asked in terms of attitude are tool usage and care, safety, work habits and many others. The way this sample test has been developed is to give the individual a choice of two items. In each case the items are rated in terms of their being negative, positive, very negative or very positive. By varying the combination of choices, pattern of responses develops. Take the three sets of responses presented in the following example, and assume that the choices marked have been selected by a given individual, what does this tell?

Given a choice I would rather:

*A. Use a chisel as a screwdriver or
B. Talk to my friend.

A. Put a broken tool back on the rack or
*B. Use the wrong tool so long as the tool is not harmed.

A. Help a friend who is having trouble or
*B. Finish my own work.

*A. Finish the project I am working on or
B. Start a new project.

In advance of administering this type of examination either the teacher or a jury of teachers should have defined, first, the statements in terms of their degree of positiveness and, second, grouped the responses according to the basic areas as presented above. If that had already been done it might be found that, from the statements above in combination with others, student A has a positive attitude in terms of respect for the work of his own; student B has a somewhat positive attitude in terms of tool usage; and student C has a negative attitude in peer relationships. Of course, the few responses given here serve only as an example. The forced preference test may in fact seem unfair inasmuch as the individual could be confronted with two bad choices. The only justification is that one choice should be better than the other, that being the case the individual is not penalized for choosing a negative response but rather is penalized if he makes the worst of two choices.

It should be understood that this instrument as presented is only in the developmental states, it must go through many more modifications before it will be finalized.

As a point of interest, possibly one use of this test would be in a prepost arrangement where there could be verification of the formulation of positive values and attitudes.

One assumption which has been made is that there is a correlation between the values and attitudes as determined by this test and the overt activities in the classroom which relate directly to the areas identified, i.e., tool usage, safety, etc. In order to validate the findings of the test, one could take the observations obtained in the method previously presented and check the degree of correlation between these observable acts and the results of the forced preference examination. One should expect a positive degree of significant correlation which tends to support the validity of two proposed techniques.

SUMMARY

Hopefully a lot of ideas have been presented and much new and old information of value has been passed on. Evaluation is a process which throughout its existence has been changing. Change is a major element of evaluation. If there is no change, then there is little need for the evaluation. This brings up a point which should go without saying, evaluations which take place and which are not shared with the individual do nothing to help that individual improve or change. Possibly, not all the information gathered through the use of these evaluation instruments should be recorded for just anyone other than the individual involved. The values and attitudes which one attempts to measure are a function of the evaluators and as such might not possibly be those which the individual being evaluated should or could be held responsible for. This is not to say that the information gathered in the spirit of determining progress and position is bad, but no matter how good anything in this world is it can be used improperly. It is for this reason that one must set out to find the most positive ways in which to determine educational progress and the most ethical and objective way of reporting it.

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Research

ERIC: A Source of New Horizons in Industrial Arts Education

Richard C. Erickson

Professional educators are continually searching for new horizons or new ways to function more effectively in their current and anticipated positions. It is recognized that for any professional to respond creatively to present challenges and to anticipate new ones he/she must keep abreast of the recent developments in his/her field and related fields. However, the vast amounts of information and resources for focusing and shaping professional practice makes it difficult for the unaided professional to keep up with these new horizons.

The purpose of this paper is to briefly present and explore an aid or information system that industrial arts educators will find useful in helping them to identify and learn about the new horizons in this area of education, the NIE sponsored Educational Resources Information Center (ERIC) and its Clearinghouse in Career Education. The paper will offer a brief overview of the ERIC system, identify and present example types of items in the ERIC data base that would be useful to industrial arts educators and briefly discuss the techniques that can be used to obtain information from the ERIC system.

WHAT IS ERIC?

ERIC is a national information system designed, developed and implemented some ten years ago by the U.S. Office of Education, and presently is administered by the National Institute of Education. The purpose of the system is to provide ready access to descriptions of exemplary educational programs, research and development efforts in education, and related information and materials from disciplines outside of education that can be used in preparing and offering effective educational programs. Through a national network of sixteen specialized clearinghouses (each focusing on special areas within the broad field of education) current significant information is monitored, acquired, evaluated, abstracted, indexed and listed in ERIC reference publications. The combined efforts of the ERIC Clearinghouses have resulted in a tremendous data base or collection of resources in education.

The ERIC Clearinghouse in Career Education is at Northern Illinois University and it has as its area of focus or scope the literature in industrial arts, adult, vocational and technical, and career education. ERIC/CICE is by far the largest single contributor to the ERIC data base.

WHO USES ERIC?

Educators of all types use ERIC. Teachers, administrators, supervisors, curriculum specialists, industrial trainers, researchers, career guidance personnel and state department personnel are some examples of those who find the ERIC data base a useful resource. Moreover it is a particulary valuable resource for industrial arts educators seeking to:

1. Learn about new instructional techniques and materials in industrial arts education.
2. Identify and apply new program management tools and practices in their local programs.
3. Discover materials and projects useful for their professional development.
4. Keep up to date on new developments within their technical specialty.
5. Obtain the latest information for preparing proposals for research projects and/or for new and expanded programs.
6. Keep up to date on research in industrial arts education and related areas of education.
7. Build a personalized, low cost professional library.

WHAT DO THEY OBTAIN FROM ERIC?

The ERIC data base includes many types of materials ranging from journal articles, project reports, curriculum guides, research reports, bibliographies, to conference presentations. Because ERIC/CICE is by far the largest contributor to this data base, industrial arts educators who approach this data base with one or more of the foregoing reasons for doing so will certainly obtain some valuable output.

The key to the data base is the ERIC descriptors, or vocabulary of terms used to index each document included in the collection and make it easy to retrieve documents either by a manual search or through the use of a computer search. The documents themselves, once located, are available either from their originating source or from ERIC in paper copy and/or on microfiche. The latter is a photographic process that reproduces documents on approximately 4 by 6 inch film cards which can accommodate up to 98 pages of normal sized text. Most colleges and universities concerned with teacher education and state departments of education will have in their libraries microfiche for all documents that have been entered into the ERIC data base, which currently number in excess of 200,000 documents and continues to grow each week. The ERIC collection truly is a library of the future. It is a library without walls, books, shelves or card catalogs — a library where the stacks or the entire collection of up-to-date published and unpublished materials can be quickly searched either by reviewing bound and indexed abstracts of these materials or by using a computer search.

This library has the power to assist its users to obtain the most comprehensive collection of information in areas of their choice — and do it quickly. As indicated earlier, the key to this unique library is the ERIC descriptors. They are presented in the Thesaurus of ERIC Descriptors. Each document is assigned several descriptors or terms as it is indexed and entered into the ERIC collection. These descriptors then can be used to assist users in searching the data base and identifying documents that contain what the user is currently seeking. For example, the Thesaurus contains terms such as aerospace, graphic arts, power mechanics and similar terms which might be used by industrial arts teachers, depending on their information needs.

ERIC also prepares two other publications to assist users — Resources in Education (RIE) and Current Index to Journals in Education (CIJE). RIE is a monthly abstract journal announcing all the materials that have been entered into the ERIC data base during the time period covered by that particular issue. Each entry in RIE is indexed by subject, author and the institution which developed it.

CIJE is a monthly guide to the periodical literature which covers more than 700 educational and education-related publications. It contains brief annotations for each entry and is also indexed by subject and author.

WHAT ARE SOME USEFUL WAYS FOR INDUSTRIAL ARTS EDUCATORS TO INTERACT WITH ERIC?

The ERIC microfiche collection, its associated publications, and CICE can be approached and made to work for you and other industrial arts educators in several ways. For example, newly received issues of RIE and CIJE might be browsed each month by

individual teachers and administrators or systematically monitored by a selected local reviewer who forwards listings of documents that would be of interest to various local professional personnel, including industrial arts personnel. In addition to providing a general overview of what is happening in a particular area, such browsing or monitoring usually leads to reviewing in their entirety one or more documents that prick one's interest. Such documents can be retrieved from a local ERIC microfiche collection, purchased individually from ERIC, or obtained from their original source.

Reviewing in depth all documents in a particular subject area is a second way industrial arts educators might choose to use the ERIC collection. For example, a drafting teacher might choose to review issues of RIE and CIJE to identify all documents that have been entered under subject areas like drafting or engineering graphics, and select those that he/she desires to review in depth in order to keep current with the latest developments in the field. These documents would then be obtained from one of the afforementioned sources.

As industrial arts educators begin to undertake tasks which require an indepth literature review (i.e., when developing new programs, significantly upgrading existing programs, or conducting research projects) they will want to do an indepth search of the ERIC collection to find everything that is pertinent to their selected task. In these instances, the ERIC Thesaurus would be consulted to identify all descriptors relating to the task. These descriptors would then be used in conjunction with current issues of RIE and CIJE (and the annual indexes for both) to identify all documents in the ERIC collection that should be included in the literature review. Of course, an indepth search of this type is facilitated greatly if a computer is used to search the ERIC tapes. The computer output contains the same resume information as that presented for the document in RIE or CIJE.

ERIC/CICE is one among several installations across the nation that has the capability to do computer assisted searches of the ERIC data base. It provides this service to in-scope users at a nominal cost as a part of the NIU Information Program in Career Education. In-scope users can initiate a computer search of the ERIC data base either by mail or by telephone. However the latter approach has proven to be the more efficient and effective approach.

When reoccurring requests for searches in a particular topical area become numerous enough to become obvious, ERIC/CICE prepares an informal bibliography for that topic and includes it in its informal bibliography series. These bibliographies contain author and title indexes, may be purchased at a cost far less than that of an independent computer search, and are mailed out in the return mail. A listing of the currently available informal bibliographies is available from ERIC/CICE upon request.

ERIC/CICE also has developed and implemented a system for selective dissemination of information (SDI) that can be purchased by individuals or institutions on an annual subscription basis at a moderate cost. The SDI program provides, on a quarterly basis, an update on all documents that have been entered into RIE and CIJE in a prespecified area of concern during the past quarter. For example, an individual industrial arts teacher might subscribe to receive resumes for all documents concerned with a subject area like power mechanics or graphic arts. Once the area of interest is identified the SDI program will provide, every three months, an update on the materials that had been entered into the ERIC collection in that subject area during the past quarter.

A brief overview of ERIC, what is in it, and some useful ways for industrial arts educators to make ERIC/CICE work for them has been presented here. The emphasis has been on the power of ERIC and ERIC/CICE to assist them obtain information quickly, accurately, and inexpensively. The educational programs and the youth and adults that each of you seek to serve certainly deserve the added efficiency and effectiveness that ERIC/CICE can bring to fulfilling your information needs if you choose to use it as a source for new horizons in your industrial arts program.

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Heritage to Horizons in Industrial Education Research

Robert L. Shearer

> "To most educators and laymen alike, the success of the school is determined by the events which occur during the educative process: the curriculum."
>
> Daniel L. Householder, 1972

Curriculum research in industrial arts education has changed significantly in the past fifteen years compared to previous periods. Studies in methodology, learning theory, instructional theory and teaching-learning activities have brought about new instructional designs within industrial arts programs in America. This is a brief assessment of curriculum research activities past and present, and future needs for research to direct and improve curricular offerings.

Two basic assumptions should be made at this point. First of all, our time allocation does not permit us to give explicit details of these research projects and it is assumed that interested persons would examine specific research projects independently. Another assumption here is that not all research activities have been reported in the literature. Some studies may be in various stages of development and have not yet been published.

CURRICULUM DEVELOPMENT

Although an historical review is beyond this report, a brief look at the curriculum design of our past may help our discussion of the present and future. From its inception as manual training, the curriculum within this discipline was influenced by the Russian system of progressively more difficult manipulative exercises to develop the class into skilled workers. (Bennett, 1937) The Sloyd system of education emphasizing individual instruction was also a significant contributor to the establishment of manual training. As a distinctively different program of instruction, manual training claimed that it met several objectives within the American educational system that the above mentioned disciplines could not meet such as: Stimulating invention, reducing the drop-out rate, improving interest in other school subjects and more. This put manual training in a position of serving both general education and vocational education. (Householder, 1972.)

Manual arts instruction grew from manual training because its methodology emphasized individual projects and student design activities, therefore, a reduction in the occupational centered content. (Feirer and Lindbeck, 1964.) Industrial arts then developed from manual arts as an accepted discipline title and is defined as the "study of the changes made by man in the forms of materials to increase their values, and of the problems of life related to these changes." (Bonser and Mossman, 1923.) The preceding devinition has generally been the guide for curriculum development within industrial arts education.

Householder (1972) illustrates three guidelines in curriculum development efforts — a psychological base, a social base and a subject matter base. The specialists and other personnel working toward curriculum development in industrial arts education should certainly consider more than subject matter in designing a curriculum. The total individual and his social environment should be considered. The psychological base looks at the sum total of all the individual's experiences — learning, skills, habits and attitudes. The importance of what is being taught is not how relevant it is to the curriculum designer; but how the student will "accept, internalize and utilize" (Householder, 1972) what is being taught.

The social consideration provides a base for curriculum development for two reasons. First of all, one of the accepted traditional functions of our educational system is to transmit the culture and social way of life to our youth. Secondly, since members of society never work in complete isolation, the social base emphasis is definitely a necessary inclusion into the curriculum design.

The subject matter base is one of the most prevalent approaches to curriculum development. Within this approach an organized body of knowledge serves as the content for school subjects. Question! How much should be covered? Should the subject matter approach be conceptual, technical, discipline-oriented or student-oriented? The conceptual approach for example gives an emphasis toward illustrations, demonstration, experi-

mentations and other broad experiences but offers less technical knowledge and skill development. Is this what we want our students to experience? This question has not yet been completely answered, for the range of curriculum research in the past has produced a variety of programs now in existence.

In an analysis of curriculum Householder (1972) describes sixteen approaches to curriculum development centered around the following headings: industry, technology, individual developed programs and career-occupation programs. Special program titles are listed below under each category.

1. Industrial Centered Approach
   Alberta Plan
   American Industry Project
   Enterprize: Man and Technology
   Functions of Industry
   Industrial Arts Curriculum Project
   Orchestrated Systems Approach
2. Technology Centered Approach
   Industrial Arts as a study of Technology
   Technology as a Discipline
3. Individual Development Emphasis
   The Maryland Plan
   The Georgia Plan
   Technology for Children
4. Career Oriented Emphasis
   Occupational Development
   Partnership Project
   Galaxy Plan
   Introduction to Vocations
   Career Development for Children Project

From the preceding list of programs, most of which are locally or regionally popular, only a few are in widespread operation and known across the nation. Namely, the American Industry Project, Industrial Arts Curriculum Project, Industrial Arts as a Study of Technology, the Maryland Plan and possibly the Georgia Plan are most widely known to the profession. Which programs should be adopted? Should we have a national curriculum for industrial arts education? What direction should we follow in basing an industrial arts body of knowledge? Should it be conceptual or skill development or something in-between (if here, what degree of emphasis toward skill or concept)?

At this time we really have a fragmented curriculum approach, that is, only certain courses are offered in some programs. Also, we have a mixed and overlapping curriculum within some school systems (lack of coordination between the elementary, junior and senior high school offerings). How then should a school system develop an organized sequential curriculum? Also, in developing a curriculum that is relevant to today's industrial-technological society, how do we keep our laboratory activities up-to-date with industry? There are several questions, then, that must be answered in order to proceed with an effective curriculum development. As a professional discipline, we should focus in on these questions which will be difficult to answer. Once we decide on our direction and give guidelines to individual states (or regions) from which a design for curriculum can be planned we can utilize new methodologies, audiovisual materials and instructional techniques for future curriculum innovations.

METHODS AND INSTRUCTIONAL ACTIVITIES

Most curriculum review and revision efforts in recent years have concentrated upon the preparation of new and improved materials. There are now numerous textbooks, modules, films, tapes, overhead transparencies and other materials for use by teachers to develop competencies for creative teaching. If properly utilized, these materials should bring significant changes in the nature of teacher-pupil relationships. The installation of such materials as a method of instruction will undoubtedly affect the learning

environment and, therefore, should affect the final outcome — development within the student. Many "learning packages" have been developed which give the teacher guidelines, workbooks, etc., and aid in teaching particular "skills" or "concepts." Perhaps the most visible of the latest methods of instruction has been materials designed to facilitate creative thinking. These materials are available in many areas of education (except ours) and should be a future research consideration for the industrial arts curriculum.

Student-teacher activities to develop an understanding of our technological culture (conceptual or industrial-technical in nature) have been proposed and implemented including aming, simulation, scenarios, cross impact analysis and programmed instruction (as well as others). The key in utilizing these activities is the motivation of students which is probably one of the largest complaints of teachers. Why? Look at their methods of instruction, use of audiovisual materials, demonstration techniques, student activities and evaluation procedures. Examine the evidence. Where is the motivation breaking down? Is it the curriculum, facilities, attitudes or what?

As an example of a new instructional technique, "cross-service courses" is an approach that vocational education is using that implements a technique of team teaching. The difference is that instead of using several teachers with special interest and expertise in one material area, many laboratories are used to teach several material areas with two or more teachers. This might be a possible instructional technique if the cluster curriculum approach becomes a reality.

SUGGESTIONS FOR CURRICULUM RESEARCH

Industrial arts education has a definite place in our educational system in the years ahead; but we can obviously see a need for further investigation into our curriculum. Research may find evidence from which we can make intelligent decisions about our future goals, objectives and content guidelines. A truly interdisciplinary approach may be the answer to coordinate curriculum and include many age and ability levels within the school. Projects dealing with history, economics, science, etc. have been mentioned but never really implemented on a large scale program.

The teacher education programs should be active in developing a process whereby their graduates can intelligently participate in curriculum development and assume responsibility to research the unknown. Innovative research and proposals for new curriculum endeavors have not been compared to other research, they have been approved on their individual appeal as logical, rational and stable. A comparative study should be made within industrial arts. There should be comparative studies made to evaluate the effectiveness of various curriculum efforts.

IN CONCLUSION

The horizons for research within the industrial arts curriculum are certainly open for investigation. Some decisions should be made to narrow the guidelines and give a more positive direction to the development of curriculum ideas (mainly in subject matter content). But there are certainly a wide range of learning activities, teaching devices and student-teacher activities that can be researched to develop the best possible instructional program for the industrial arrs curriculum. Methods, programs of presenting subject matter and activities to reinforce subject matter to students can be a tremendous motivating factor and an open ended research field.

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Industrial Arts Research: Basic Considerations

James T. Ziegler

PHILOSOPHICAL CONSIDERATIONS

Educational philosophy has been described as an identification of "what should be". More specifically, an educational philosophy is a thought process which seeks formalization and acceptance. Industrial arts has had the benefit of a number of persons who have expounded on the subject of "what should be". The results are characterized by diversity rather than consensus. Our heritage in the research of industrial arts philosophy is, at best, in an evolution phase. This phase has not enjoyed the constant progress associated with most evolution. Several reasons can be identified as possible causes of the slow progression. These reasons must be considered for the total spectrum of industrial arts research.

Many documents, the most recent of which is a National Institute of Education report, indicate that the majority of educational research is conducted via dissertations and advanced degrees. It is obvious that the incentives of pursuing an advanced degree at the present time are not at optimum. One must consider the fact that the frequency of dissertations may decrease in the near future. Data exist that provide indications of the decline.

Assuming that industrial arts enrollments in colleges and universities will remain stable and that the retirement age is sixty-five years of age, the following study was conducted. A frequency distribution of the ages of persons engaged in industrial arts teacher education was constructed using the Who's Who in Industrial Arts. This information then provided indications of attrition due to retirement from industrial arts. Thus, we have one indicator of the needs of the profession. These needs are given in five-year intervals. (See Figure 1).

Figure 1

ATTRITION THROUGH RETIREMENT IN INDUSTRIAL ARTS TEACHER EDUCATION

Years	Demand
1976-1980	96
1981-1985	173
1986-1990	206
1991-1995	173
1996-2000	234
2001-2005	162

As these figures indicate, the chief source of our research may diminish rapidly. In those cases where research is being conducted in our discipline, it must be noted that research is usually not the prime function of the individual. Nationally, it is estimated that a maximum of 10,000 persons are engaged in educational research. If the National Institute of Education becomes a companion to the National Institute of Health and the National Science Foundation, 20,000 full-time researchers will be needed. This is a bright spot on the horizon.

Additional reasons can be suggested for the lack of philosophical research. First, while most recognize at least three types of research, it appears that one type has become a criterion for excellence. In the early 1960's industrial arts became fascinated with the status of experimental research. Similarly, a cursory review of dissertation topics reveals the mass movement toward this research method. Such a movement has created gaps in other methods of research. A second reason might be attributed to a change in the posture of educational research. The shock wave of Sputnik sent oscillations throughout the educational research field. A new emphasis was placed upon the social and practical application of research. Most recently, the purse strings have centralized in state and local units of education. Such movement may reinforce the trend and acceptance of experimental research.

A third reason for a lack of interest in philosophical research might be centered on the concept of who cares. Our discipline does not have a true national forum for discussion of critical issues. Many of us are familiar with journals in our auxiliary disciplines which present position papers with one or more reactions. What do we have in industrial arts? What opportunity is there for a national reaction to the latest teacher education yearbook which suggests a change in name for industrial arts? Do we react to suggestions or rationalize them out of existence?

The horizon of "what should be" will hold attractions that we must deal with. As will be noted shortly, our evolution of philosophy may accelerate rapidly.

CONSIDERATIONS FOR OBJECTIVES

During the past few years it has been difficult to avoid a statement such as this:

> ...a complete description of the ...curriculum — including the sequential learning needed within the body of knowledge, skills, attitudes, and values as identified through instructional objectives....

Is this statement from a textbook or from the ivory tower? No, this is a typical requirement that many colleges and universities are facing as the education of teachers changes. It is an immediate attraction on our horizon. It is perceived that no phase of education will go untouched by such requirements. The focal point of such a statement is objectives. The research opportunities become numerous. Consider just two points: (1) identification of objectives and (2) sequencing of objectives.

Industrial arts is well acquainted with methods of identifying objectives. The methods range from task analysis to consensus of rank ord . It might be suggested that these identification processes are highly related to justification for existence. If this be the case, it behooves each of us to explore, identify and consolidate those objectives that contribute to the cognitive, affective and psychomotor development of the student.

Sequencing? That is no problem. Bloom and associates have provided guidance. Several have provided the mechanics. The taxonomies of the cognitive domain have been expounded for a quarter of a century. No problem, right? Wrong!

Less than ten studies have been directed toward the hierarchical structure of the taxonomy of the cognitive domain. In fact, while two studies concluded only mild support for the lower levels of the taxonomy, three studies gave results that indicated reversals in the structure. While these studies have generated controversy over analysis techniques, they have provided examples of research tools that may provide answers to the sequencing problem.

One plausible technique is multidimensional scaling. Briefly, this scaling technique constructs a configuration of points in space from information about distances between the points.

Each of the points represents the location of an objective in relation to all other objectives. This technique utilizes the heritage of Thurstone, Torgerson and Young. The

technique begins with the selection of objectives. For simplification, only the infinitives and direct objects are used as the objective statement. Some examples would be:

read a schematic diagram
use Ohm's Law to predict current
identify four sources of electricity

The objectives are then presented in all possible pairs to persons who have knowledge of the content of the objectives. These persons then rate each pair on a seven point scale of similarity. If the pair of statements are rated as similar, the behaviors are considered to be operationally close. The less similar the pair are, the greater the distance between their operational levels. When the resulting data from the ratings are submitted to a multidimensional scaling program, the distances between all behaviors are determined. This provides a visualization of the location of each objective in respect to all other objectives.

The proper selection and sequencing of educational objectives for any discipline has been well documented. In industrial arts, a decade has passed since it was suggested that a national effort be made to identify the objectives of our discipline and subject these objectives to a systematic order. This has not occurred and we find an increasing need to follow the suggestion.

CONTENT CONSIDERATIONS

With our heritage in philosophy and objectives, it would be expected that our content represent diversity. The present status of our diverse content has not always been the rule. A brief view at history gives these points of emphasis:

1876–1899: tool instruction, visualization, appreciation
1900–1916: industrial processes, occupations
1917–1929: national needs (bird house, manpower)
1930–1949: technology, processes
1950–present: clusters, career education

It must be noted that these groupings are cumulative, with our present emphasis containing portions of all previous content. With this prospective, it is little wonder that status studies on content produce long lists of concentrations of emphasis. Previously, the following constructs of content were identified (given in rank order):

1. technological literacy
2. career awareness, orientation, exploration
3. cultural awareness of industry
4. use of tools and materials of industry
5. vocational recreational expression
6. problem solving

Further, an investigation of program objectives reveals groupings of objectives. (See Figure 2).

Figure 2

General Objectives of Selected Curriculums by Frequency of Statement in Literature

Objective	Number	Percentage
Industrial Orientation	22	66.6
Interdiscipline	19	57
Pre-vocational skills	14	42
Vocational Career	11	33
Problem solving	8	24
Motivation	6	18

Thirty-three programs were selected from the literature and the stated objectives were used to provide indicators of content emphasis.

What is the content of industrial arts? Is the content exclusive or inclusive? Are we at a point where formal comparative research might be in order? These basic questions will need to be answered.

With these questions facing industrial arts, it is difficult to ignore some of the research techniques presently associated with the study of the future. The Delphi technique is an example. However, caution is again required for the use of this technique as it is for every technique. One study used the Delphi technique to identify problems associated with the adoption of the metric system. The researcher emphasized that he used experts who were pro-metric, noting that anti-metric experts were difficult to find. These situations could compound our problems.

The heritage of industrial arts content has been as interesting as any discipline in education. Yet, the horizon holds attractions that promise to be just as interesting.

CONSIDERATIONS FOR EVALUATION

A look toward the horizon in industrial arts has one dominant feature. That feature is evaluation. Evaluation may require consolidation of our views. Evaluation, in many cases, is asking, why do you exist?

It would have required supreme isolation during the past few years to avoid the growing tide of support for competency based education (CBE). This movement is receiving support from several areas.

On one front, many states are involved with an activity called teacher education redesign. The variety of plans for these redesigns lend themselves to the constructs of CBE. Additionally, evaluation of several fields, such as science and reading, has shown a drop in a descriptor known as functional literacy. Such evaluations become fuel for the fire. The philosophy changes, the objectives change and the content changes. What if a measure was made of the technological literacy of students of industrial arts?

The areas of needed research in evaluation would require pages for listing. For example, in the near future someone, somewhere, will decide the characteristics of a good industrial arts teacher. With the advent of system analysis, it has been determined that the quality of the output can be improved by improving the quality of the input. Who will make these decisions? Another example deals with the aforementioned functional and technological literacy. Just what is this? What will guide our discipline, the input or the output? Industrial arts research has barely touched this area; thus the horizon holds promise of additional needed research in this area.

Research in industrial arts philosophy, objectives, content and evaluation indicates many directions for needed exploration. It has been noted that this discipline is young. It has also been suggested that we do not have the capability of providing a concentrated research effort in our areas of need. Look at our heritage and look at our future. Will we be proud of our future?

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Safety

Protecting Teachers Against Liability Suits

Richard J. Flanigan

To try to cover the subject of liability law in the short time we have to talk about it is somewhat like doing a one paragraph history of man. The liability area of law is one with rapid changes, nearing the crisis point like the malpractice area and one the teaching profession is deeply involved in, yet in many instances remains unaware of its vulnerability.

In 1975 over one million of this type of suit were filed in state and federal courts. Ten years ago, less than 200,000 suits a year were filed. To say it succinctly, your chances of being involved in a suit have improved tremendously.

There are many reasons for this proliferation of litigations not the least of which are the following:

1. Consumerism and consumer awareness of their rights.
2. A development of a strong plaintiff's bar.
3. Changes in tort law — strict liability and the reduction of defenses.
4. The deep-pocket theory.
5. Spread of the comparative negligence theory.

Some of the above are self-evident; others will be developed in my presentation.

To give you some past history and a better understanding of tort (fault) law, previously as far as a manufacturer was concerned he could remain relatively unconcerned since three factors were necessary for a plaintiff to recover. These were a contractual relationship between the plaintiff and defendant, negligence on the part of the manufacturer resulting in a defective product leaving his plant, and a causal (cause-effect) relationship between the defect and the injury.

Today, in most states the theory of strict liability prevails. By this we mean that if there was negligence or a defect, and it was continuously causal, then the plaintiff can recover.

Negligence can be for the teaching profession:

1. Failure to act so as to protect others from unnecessary risk (removing safety guards).
2. Failure to act as a prudent man would (allowing use of defective equipment, leaving the classroom, etc.).
3. Lack of care or due deligence (failure to inspect and/or maintain machines).
4. Allowing third parties to use or engage in an activity which can result in jeopardy on their part.

As far as the manufacturer is concerned, his product can be considered defective if:

1. There was a defective part.
2. The product is deemed unreasonably dangerous.
3. There was a failure to warn of an unknown hazard condition.
4. The product was improperly designed.
5. Codes and standards were violated.
6. The product was not fit for the intended purpose.

Let us first look at who can be sued and then in your field each type action in which you could be considered negligent and what you should be doing about it.

Anyone in the stream of commerce and having a relationship to the product on which an injury resulted can be sued except where common law is not abrogated (set aside),

that is the supplier, the manufacturer, the manufacturer's representative, the distributor, the school board, the school administrator, the involved teacher and other students causally related. The only member of this group in what I call the liability chain (which links us all together) that will be out of it in all but 12 states is the school board. In the remaining 38 states they have common law immunity; i.e., as part of government they cannot be sued. In those states where they can be, the change has been brought about either by state law or the state Supreme Court decision. There are no states in which a teacher cannot be sued although seven states do have save-harmless laws in which the state indemnifies the teacher from loss resulting from a job related liability judgment.

The basic claim in most suits is for compensatory damages. This type relates to compensation for the loss suffered. There is a recent trend towards asking for punitive damages as well. This type relates to punishing the defendant for his wrongful act. Punitive damage claims have two serious effects in that they tend to increase the value of the suit and in most instances are not covered by general liability insurance policies. If punitive damages are awarded by the jury it could come out of your own pocket regardless of the insurance protection you may have.

In school related incidents you are vulnerable and could lose your home, property, investments and other real property you may possess if a judgment is rendered against you. I am sure many of you have professional insurance, but would it cover a 250,000-dollar or more judgment? The 1,000,000-dollar judgment is not uncommon today; in fact, I am aware of one involving an industrial firm for 5,500,000 dollars. From the standpoint of the plaintiff's bar, between 25 and 50 percent of such a judgment is very attractive and lucrative; well worth the effort and expense of putting on a strong plaintiff's case. Hence, the development of a strong plaintiff's bar. The last time I looked at the statistics, the winning ratio of cases taken to jury was at 52 percent for the plaintiff. Juries today tend to feel if someone has been injured, someone has to pay; the deep-pocket theory is that the one to pay is the one best able to pay.

Before we get too deeply into those areas where each of us has a responsibility and where we can be self-protective, all of us need to be totally aware that when it comes down to cases, all of us in the liability chain end up on the same side of a liability suit. Based on that, we need to be group-protective as well as self-protective.

To elaborate on the areas where your liability problems are related to negligence, let us take a look at the basics of shop safety. To me, a safety program consists of:

1. Proper training.
2. The right machine, properly equipped and in good condition.
3. The right setup — tools, fixtures, clean table, clean work area, etc.
4. Enforcement of safety rules and practices.

It should be self-evident that it is the responsibility of a shop teacher to know thoroughly the machines in his classroom. He should know how to operate them in a safe fashion, how to fixture them for safety, and what hazards are related to their use. It is also expected under law that a teacher will provide adequate training to his students before he allows them to use the machines. If he does not, he can be judged negligent.

In order to be self-protective, many instructors use written tests as evidence that students have been trained on a particular machine. This is good practice and it is a document which should be retained as a permanent record for as long as students remain in the school system. The purpose of this is to help to protect other future teachers and the school system. In fact, each student should be required to retake the tests at the beginning of each school year before he is allowed to use the machines. The reason behind this is simple; it will show that you have an interest in the safety of those you are responsible for by reexamination of their knowledge.

Another area of training where you can be found negligent is when you teach or perform operations which are contrary to good safety practice. In one case I was involved with on a wood lathe, the instructor taught the students improperly that they could perform certain operations on a wood lathe from the rear of the machine. It is prophetic that a student was operating the machine from that position when a 12-inch diameter wood bowl exploded, striking the student in the face and resulting in permanent, disabling brain damage. This same instructor also allowed students wearing prescription glasses to purchase nonprescription safety glasses. State law required that all shop students were to have safety glasses, but as you probably realize, nonprescription glasses are less

expensive. At the time of injury, the student was wearing his prescription glasses.

In a recent incident involving a table saw, the instructor had built a taper fixture for cutting table legs. In the text from which he had gleaned the design of the fixture, it clearly stated that the guard and splitter assembly did not have to be removed to use the fixture. The instructor taught the use of the fixture with the gard removed. A student using it was distracted and his hand contacted the blade causing serious injuries.

One lesson to be learned from this is always teach and use the safest possible method performing every operation, even if you disagree with the necessity of doing so. Use push sticks, push blocks, feather boards, facing boards, and every safety device available to make each operation safe. It is better to train your students to take a few extra minutes in the best and safest setup than to face a law suit. If you think your way is safer than recommended practice, document it and prove it before you use it. What you say and do can be used against you.

If you are responsible for the maintenance of your machines, follow a few simple rules:

1. Do it right.
2. Check that it has been done right.
3. Document what was wrong and what you did to correct it.

In another maintenance area, whether you are responsible for maintenance or not, keep a permanent record on each machine which allows you to log each time you make your periodic safety check on it. For your own benefit and the safety of your students, you should safety check periodically each of the machines in your classroom and record the fact that you did with a check list for each machine dated and initialed. If there is something wrong or missing, red tag the machine and do not allow its use until the corrections are made.

Another point on safety is the use of decals or signs warning about certain basic safety practice, such as eye protection. If you do not use them, you could be considered negligent regardless of how you may feel about their benefit. We know that unless coupled with a good overall safety program, they have little effect.

You should review how your shop is laid out. Do you have any work benches or major traffic aisles in line with machines that can have a kickbac' such as table saws, jointers and planers? In a case my company is involved in, a student at a work bench was fatally injured by a kickback on a table saw that threw a board 16 feet and struck him at the base of the skull. The workbench area was in line with the direction of a possible kickback and the guard, splitter and anti-kickback assembly was not on the machine. If you are aware of this type danger and an injury occurs, you could be found negligent.

There have been proposals on using class and machine waivers in school shops similar to those used in athletic programs. These can be valuable in negating recovery by parents for loss of services. With this form, the parents of the student waive recovery of themselves for loss of services in the event of injury. Rights of a minor student cannot be waived, however, and even the parents might still recover if your actions were unconscionable. Of age students, such as those in college or a trade school, can waive their right to recovery. Waivers of this type may seem politically unpopular, and at present are not used to any great extent, but if used they would be a recognition by parents and consent individuals that there are hazards in using power equipment and the claim of unrecognized dangers could be invalid.

As a final area in your protecting yourself, you should know the hazards associated with the machines in your shop. To give you an example, consider a wood lathe turning at 4,000 rpm with a 12-inch diameter bowl mounted to a face plate. I am sure you recognize this as being too fast a speed for this size bowl, but do you truly recognize the extent of the danger? If the bowl explodes under the above conditions, a 6-ounce piece coming off that bowl will have the same impact as a 1-ounce shotgun pellet at muzzle velocity. To say it another way, it is like putting a shotgun against your head and pulling the trigger. Rotating bodies pack tremendous force. In a recent incident involving a wood lathe, a student wearing a face shield was turning a large bowl when it exploded. The force was of such magnitude that the face shield shattered and serious head injuries were the result. Consider also what happens to wooden objects when they are left for a period of time. Wood will swell and contract and can develop checks and cracks. One bowl explosion occurred on January 2, so you must consider what happens in school buildings during

shutdowns. Also on laminations, grain should not be all in the same direction since wood is weakest in a force direction perpendicular to the grain. The weakness needs to be directionalized and reduced — not maximized.

Considering table saws with a peripheral saw blade speed of 12,000 ft/min, the time for a board kicking back at that speed to move 6 inches is .025 seconds. Human recognition time, that is the time for a danger signal to reach the brain, is .03 seconds. To say it in other words, the accident has occurred before the person involved even recognizes something has happened. To put it another way, never use a table saw without a guard, splitter and kickback assembly on it unless there is no other way to do the operation such as dadoing.

Other areas that work can be done about this problem as a group rather than an individual basis are:

1. Reducing or eliminating common law immunity. This could have the positive effect of forcing school boards to take more interest in safety, safety requirements, and proper maintenance of the machines.
2. Working toward an extension of the save harmless states where the state will indemnify the teacher from loss in a liability suit where the individual was performing his duties in a proper fashion.
3. Review the advisability of the use of power equipment in junior high schools. If this age group should be exposed to power tools, what kind should they be and under what circumstances should the student be allowed to use them. Consider the maturity of 13 year olds. How much responsibility would you grant as opposed to allowing their unrestricted use of another piece of hazardous power equipment, the automobile.
4. What action should you take as a group in letting those in Washington, D.C., know the growing seriousness of this problem. Should there be a products compensation law like workman's compensation? It is not that any of us want to deny a plaintiff his right to recover but left to the sympathy of some juries, some awards have been astronomical.

At the present, the future does not look too bright. As manufacturers, we see the problem as producing:

1. More suits.
2. Higher awards.
3. Higher cost but safer products because of new standards and an awareness of possible liability.
4. The spread of comparative negligence to better insure that there will be some recovery on the part of the plaintiff and his attorney. In contributory negligent states (20 of 50), if a plaintiff knowingly contributes to his own injury he cannot be awarded damages.
5. Higher insurance premiums. In 1976 some have gone up in the area of 400 percent.
6. Some companies going bankrupt. There is one company currently paying 10 percent of their gross sales in premiums and when the policy terminates this year they will be uninsurable.
7. The advent of the fractured company structure. Small independent subsidiaries where if it is put out of business the parent will survive. Basically the form would be a holding company structure which can continue on other product lines even if one line is bankrupt, the others can continue unscathed.

Although I might be sounding like an alarmist in presenting a fairly black picture to you, this is not my intention. These suits are defensible and they can be made more defensible if each of us performs our function in an enlightened fashion. Juries can find for the facts and ignore the law. Many people in this country still believe in personal responsibility. They will not discount the fact that if a person is properly trained and has the proper equipment, the training can be ignored and if the individual chooses to do so, it is his responsibility, he assumes the risk.

Insurance is not the answer; it only serves to protect us against major loss, but it is a loss that is made up in premiums. Remember premiums are losses, plus expenses, plus profits. We or the public end up paying the bill.

You, as industrial arts teachers and administrators, and manufacturers such as my company are joined in a conflagration not entirely of our own making. But recognizing that it is a war should tune our efforts towards making the best defense possible, each of us doing what we can to be selfprotective. It is a war that cannot be won but we can keep the losses to a minimum. We owe it to ourselves and our professionalism to put every

effort into winning all unjust litigations. If we do not, we simply invite their proliferation.

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Wood Surfacer Noise Control

Edwin C. Hinckley

BACKGROUND

Noise levels in woodworking shops have always been high. The high speed equipment and related noises have been pretty much accepted as an inseparable part of machine woodwork — by most woodworkers.

Eventually a group of nonbelievers got together and were instrumental in having noise level standards written into the Occupational Safety and Health Act of 1968 (OSHA) that is having a real impact on the activities of machine producers. A visit to the 1974 International Conference of Woodworking Machine Manufacturers made me aware of some changes that were taking place in machine design and accessory items to reduce the noise level in woodwork shops. Several manufacturers features new "silent" cutterheads for surfacers; sound control enclosures were seen; one company was showing their new quiet jointer and there was talk of research efforts to reduce saw noise.

The conference was impressive. It is one of the most stimulating experiences I have ever had. The new surfacer cutterheads were things of beauty to look at, but expensive. A 24-inch unit for our surfacer was priced over $2,700. The enclosures looked like they could do the job of containing noise, but they had a passage way door in the sides for the operators to enter, with access room all around the machine. In effect, they were surfacer rooms and much too large to be placed in any industrial arts wood shop, or many small commercial cabinet shops.

I was intrigued with the possibilities of developing a minimum-sized enclosure, just large enough to cover the machine and exhaust duct, then experimenting with different commonly available lining materials to see what reduction in noise level was possible. The results would then be compared to the noise levels produced by one of the new "silent" cutterheads.

Sometime later Brigham Young University research funds became available, and a proposal was submitted. The proposal was funded. This presentation is the first report of what has taken place.

The Walsh-Healey (OSHA) regulations state:

(b) "When employees are subjected to sound levels exceeding those listed in Table 1 of this section, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the level of the table; personal protective equipment shall be provided and used to reduce sound levels within the levels of this table."

Table 1

Permissible noise exposure

Duration per day, hours	Sound level dBA
8	90
6	92
4	95
3	97
2	100
1-1½	102
1	105
½	110
¼ or less	115

The Walsh-Healey (OSHA) regulations prescribe that the A-weighted sound level scale will be used for measuring sound levels. They also prescribe 90 dBA as the highest

sound level in which a person can work for eight hours. There has been some consideration in Washington of lowering this to 85 dBA. Any procedure that will help to keep the dBA below 85-90 should be investigated and incorporated wherever possible. That was the object of this research.

Sound control involves three different kinds of acoustical control: (1) Sound absorption. Acoustical ceiling tile is a common example of a material designed to diffuse sound waves and reduce reflected noise. (2) Sound dampening. Usually this involves modification of a structure (a planer hood) by addition of a deadening material to reduce the vibration level of the structure. The material applied to the inside of a car door deadens the closing sound to a solid "thunk" instead of the original tin can sound. (3) Sound barriers. The most effective barriers are those having a high mass septum. A concrete or brick wall between two apartments provide much greater sound isolation than a frame and gypsum board wall.

A fourth means of controlling noise levels, not mentioned by producers of acoustical materials, but being seriously investigated by machine manufacturers is reduction of sound level developed by a piece of equipment. An ounce of prevention is still worth a pound of cure. The less sound there is to control, the easier the job becomes.

All four of these problems were involved in this study.

RESEARCH PROCEDURES

The term "sound level scale" will be identified by the abbreviation dBA (decibel, A scale) through the balance of this paper.

All tests were conducted on an Oliver model 299 (old model), 24 inch single surfacer with a regular three knife cutterhead for all tests with the enclosure, and the new Oliver Inserted Tooth Helical Cutterhead for the final open machine test.

The test machine was equipped with carbide knives that were sharpened just prior to the test. All tests were made using the right hand half of the cutterhead, which is typically not used by students. The standard depth of cut was one-sixteenth of an inch, one complete turn of the table adjusting wheel. All reported test results reflect dBA readings taken while cutting red oak, 48 inches long. Tests were conducted to determine if length or thickness of stock afected the dBA and the differences in readings were insignificant. Some trimming of widths was done to lower excessively high readings and make them compatible with the other stock. Each test piece of oak was checked for its noise-producing qualities prior to beginning the tests. This was done by jointing one side, and then surfacing the other side to a clean condition, after which an additional one-sixteenth cut was made during which dBA readings were taken and then written on the piece for future use.

All dBA readings were measured with an H. H. Scott, Sound Level Meter, Type 450-B. Sound level readings were taken at four different positions in the wood lab. All dBA readings were taken by the same person under as similar conditions as possible.

At 7:00 a.m. on a Saturday morning the Snell Building and the wood laboratory were very quiet. In fact, the morning we took these readings a custodian standing at the opposite end of the hall from the wood lab started talking to someone and had the meter needle dancing all over the scale. She was asked to stop, and the readings were completed to show a general background dBA of 30.

We were surprised at the dBA levels recorded. By turning on the dust collector unit the dBA jumped 35 points at the operator position, and 31 points at position number three. Comparing condition number three with number two, the surfacer by itself was found to be only slightly noisier than the exhaust system running alone. Condition four, with the exhaust and surfacer both running showed an increase of 53 dBA at position one, and 41 dBA at position three.

Have you ever analyzed a police siren to determine how it makes its sound? Reflect for a minute. Basically, you find a series of vanes on a rotating shaft moving rapidly past a series of fixed vanes on the case. Surfacers and jointers have a similar relationship of parts. Turning on the exhaust system moves more air between the vanes (knives and chipbreaker or table lips) and increases the sound produced.

Cutting oak increased the dBA at the operator's position by ten dBA to a new level of 93 dBA. This reading of 93 dBA was the base figure to which all further test results were compared.

The next step was to produce an enclosure that would be of minimum size, yet completely cover the surfacer and the dust collector/exhaust duct. Openings had to be made

for the infeed and outfeed positions, air cooling duct for the motor, the table adjusting mechanism, the on/off controls and a window to permit reading of the thickness gage. These openings were kept as small as possible to reduce sound egress from the enclosure. The enclosure was constructed from 47-pound particle board, which was the heaviest board available in the Salt Lake City area.

A plain unlined box constructed of high density particle board reduced the dBA at the infeed operators position by 9 points. Adding adjustable doors for the infeed and outfeed openings that moved up and down with the table reduced the general dBA in the lab, position three, from 67 to 64. That did not seem like much, but it was noticeable, so the doors were kept for the rest of the tests.

The next phase of the testing was to evaluate different enclosure lining materials. This phase was separated into two parts: (1) Commercial acoustical materials, and (2) "cross-road" acoustical materials, stuff that was available everywhere.

For the commercial material I contacted one of the major suppliers in Salt Lake City with whom I had worked before, told him what was happening, and asked him to propose an optimum package.

That package consisted of a layer of "Acoustilead" which is sheet lead one thirty-second of an inch thick, and an inner lining of 2-inch thick fiberglass "Monocoustic Ceiling Panel" produced by Owens Corning.

The "crossroads" package consisted of masonry sand and sanitary napkins. The sand was enclosed in a 3/4-inch deep frame covered with 1/4-inch plywood. The napkins were stapled to slats and applied like shingles with a 50 percent overlap between rows.

For all practical purposes results of tests under Condition one and Condition two are identical. It appeared from these two tests that the two inch fiberglass bat and the double layer of sanitary napkins were equally effective in diffusing and absorbing sound waves. A comparison of test results for the lead only and sand only lining indicated another trade-off with two of the four position readings slightly in favor of each lining.

The last phase of the project consisted of testing the relative effectiveness of the Oliver Inserted Tooth Helical Cutterhead in reducing operating sound level in the woodworking laboratory.

This cutterhead consisted of 84 carbide cutters distributed around the head in 6 long helical spirals. Two things resulted from this configuration. Instead of the three or four knife impacts per revolution over a 24-inch length, you now got 84 impacts per revolution with a knife only 1 inch long. The result lowered the intensity of the impact noise and changed the frequency. The second change related to the air movement noise around the cutterhead. With 84 very short cutters (rotating vanes) moving by the chipbreaker (fixed vane) the siren type noise level was lowered and the frequency was changed.

The five different tests run during this project included: (1) The surfacer with no modifications, conventional cutterhead. (2) Enclosure with lead and fiberglass lining, modified enclosure including tunnels lined with lead and fiberglass over infeed and outfeed tables, adjustable doors and neoprene rubber curtains at infeed and outfeed openings, motor cooling vent baffled and lined with lead and glass. (3) Enclosure with sand and fiberglass lining, modified enclosure as outlined in number two above. (4) Enclosure with sand and sanitary napkins, modified enclosure as outlined in number two above. (5) The surfacer with no modifications as in number one above, but with segmented cutterhead.

Using positions three and four as representative of an average dBA for the total woodworking laboratory it did not appear to make any difference which combination of lining material was used with the enclosure as the dBA's were identical. Readings for the segmented head showed it produced sounds three dBA higher than the enclosure at position three, and identical at position four.

One last test was conducted to answer the "What happens if..." question. For this test the surfacer with the segmented cutterhead was placed on vibration absorbing pads. A piece of weatherstripping sponge rubber 3/8 by 3/4 was attached to the bottom edge of the front, back and ends of the enclosure. The indexing frame around the base of the surfacer which was used to help index the enclosure for assembly was made narrower and faced with the weatherstripping also. All of the enclosure modifications were used. This was the ultimate test combining the best of our sound prevention and sound control techniques.

Remember that the dBA for an open machine with a conventional cutterhead at position one was 93 dBA. The enclosure alone reduced that figure by about 10 dBA. The segmented cutterhead alone was also good for a 10 dBA reduction. Combine the two, add

a few refinements to the enclosure, and you have a package that reduced the sound level at the infeed operator's position by 21 dBA. This combination would be excellent if the wood lab was very close to a sound sensitive area, or where the people in charge were really concerned about the well being of the faculty and students.

COST EFFECTIVENESS

Listed below are prices paid for enclosure materials used in this study.

	Amount		
High density particle board	150 sq. ft.	$ .185 sq. ft.	$27.75
Acoustilead	150 sq. ft.	.65 sq. ft.	97.50
Monocoustic Ceiling Panel	150 sq. ft.	.435 sq. ft.	65.25
Masonry sand	1/3 yd.	2.00	2.00
Plywood, COX fir, 3/8"	150 sq. ft.	.16 sq. ft.	24.00
Sanitary napkins	1213	.0563 each	68.29

The Oliver Inserted Tooth Helical Cutterhead was priced at 2,946 dollars plus freight when this was written. This includes modifications to the grinding attachment which are necessary to grind the slightly skewed teeth. The teeth are tungsten carbide.

The unit prices indicated in Table 2 below include a ten percent miscellaneous allowance to cover glue, nails, bolts, etc.

TABLE 2

Cost per dBA reduction

	dBA reduction from open machine reading of 93dBA	Unit cost	Cost per dBA reduction
Enclosure, lead and fiberglass	9	$ 209.50	$ 23.29
Enclosure, sand and fiberglass	11	104.50	9.50
Enclosure, sand and napkins	11	134.24	12.20
Segmented cutterhead	11	2,946.00	267.82
Enclosure, segmented head, sand and fiberglas	21	2,976.50	141.74

SUMMARY

Strictly on the basis of dollars per dBA of reduction, the enclosure, sand and fiberglass package is the best buy, at 9.50 dollars per dBA for 11 decibels. Of the three enclosure lining combinations tested this is also the most simple to assemble and maintain. The enclosure does have some drawbacks. It physically separates the operator or maintenance person from the machine. It becomes more difficult to read the thickness gage, clean and lubricate the surfacer, and grind the knives. Grease extension tubes running to the outside of the box would help to resolve the lubrication problem. Tungsten carbide knoves stay sharper much longer than high speed steel and reduce the frequency of opening up the enclosure. A person familiar with conventional, open machine operation, may find it a little disturbing to have his material out of sight for so long — even if the surfacing is being done more quietly. The enclosure gives visual proof that something is being done to make life more pleasant, and may provide a psychological lift.

The segmented cutterhead does a good job of reducing sound by the same amount as the enclosure, but with much less fuss. There is no visual evidence that anything is different. After the segmented cutterhead was installed in our surfacer we decided not to say anything to the students about the change and see if they noticed a difference. The first comment was made about 8:30 a.m. during the first class to use it. Student, "Is the surfacer on?" Teacher, "Yes, why?" Student, "It sure is quiet. What did you do to it?" Many comments of a similar nature have been made since then. The unit is expensive, but it does the job for which it was intended. The cutting angle of the short knives produces a shearing cut. This cutting action results in a much improved surface when highly figured grain patterns are involved.

The exhaust system produces a high sound level. It is an interesting frequency and level because a person doesn't realize how loud and bothersome it is until it is turned off.

We are now in the process of investigating different damper systems to stabilize the amount of air being drawn through the system under different operating conditions. There is also a possibility of the system being over designed. We will be investigating the effect of different pulley ratios on the operating effectiveness of the system.

The next problem is the 16-inch jointer.

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Power Tool Operating Hazards

Daniel W. Irvin

Most manufacturers who make equipment normally used in schools, or more specifically, in any industrial education program are rather well acclimated to the safety needs of schools and students. This has been true for better than forty years of Rockwell's experience in matching various strict state requirements. Naturally four or five states lead the way as far as specific safety requirements were concerned, and no manufacturer could afford to build or sell "anything less." Therefore, all products manufactured and sold to the school market on a nationwide basis adhered to these strict requirements and everyone benefited. On an industrial basis, possibly because students or children were not involved, many of the requirements were not as strict. Even if equal, they were often ignored in favor of more versatility, higher production rates and the financial benefits which accrued from these practices.

With the advent of both OSHA and the Bureau of Consumer Safety, very specific requirements have been stated as a law as opposed to being voluntary. Schools specifically — as a part of Government — are not required to match OSHA standards on a federal basis. When a state adopts the OSHA code, either in part or word for word, the administration and inspection is handled by that state. Schools are very definitely involved under the state administered programs. Although OSHA is primarily a conglomerate of many consensus standards derived from a great many places, in most cases at least the basic requirements are necessary and not a debatable subject.

Because of the many sources for OSHA regulations, there are naturally many ambiguities and contradictions in this particular law, which are in process of being ironed out. It is possible that this shake out period will last as long as ten years until all of the petitions from various associations and manufacturers are settled one way or the other. In the long haul, it is expected that this will be a most valuable and beneficial law as far as safety is concerned, both in schools and in industry.

Inexperienced OSHA inspectors also have contributed to some of the problems involving underenforcement, overenforcement and the many questions involving OSHA. This in time also will undoubtedly be solved as inspectors obtain better training and many of the "judgment factor" questions are clarified. Regardless of the serious work done and the basic intent of manufacturers, the Federal Government, state governments and educators, the prime requirement for safety — in the long run — is good operating procedures and a good mental safety attitude on the part of the student or the worker. Regardless of the guarding and other mechanical or electrical safety considerations, the mental attitude and operating procedures of the operator are still the key. Operator error might be categorized into three general areas, one being apathy, the second being stupidity, and the third being ignorance.

Apathy of course would pertain to teachers or students and management or operators who actually understand how to operate equipment safely and know all of the rules, but for one reason or another, really do not care. They are much more interested in "getting the job done quickly," making more profit, saving time, or, in general, adopting a "it will never happen to me" philosophy. People in this category are not really thinking of questions such as safe or unsafe, since the question of safety might be number ten or twelve on their list of important things. Somewhere along the line they depend on luck,

fate, the federal or state governments, and the manufacturer to solve all of their problems. They generally do not willfully do anything wrong, but neither do they, with thought and planning, do anything right. This is a rather loose attitude which may be workable in many situations, but when dealing with equipment, the mental looseness and "happiness" lasts only until they meet head on with an accident. The comments then might run "I knew better," "why didn't I think about that," "I'm sorry."

Stupidity might be defined as "attempting to get away with the improbable." In most cases this person knows the correct method of operation, but weighs his chances carefully between doing it the correct way and doing it by either a faster or more profitable method. After weighing the chances, he decides to take the risk and, in many cases, sincerely regrets his decision. In the three categories we are discussing this is probably the most serious, since actually some thought is given to the correct and safe method, but for some unknown reason the gambling instinct takes over. Stupidity is also the most difficult reason to explain once an accident has happened, since there is really no logical excuse for this type of decision or action.

Ignorance falls into the category of "I didn't know," "I didn't really understand," or just plain unfamiliarity or inexperience. In some few cases, it is entirely excusable and actually a reason. In other cases it is totally inexcusable and strictly an excuse, considering the fact that all legitimate manufacturers now issue rather complete instructions concerning equipment. Because of the many books on the market, both text and research, involving the entire spectrum from mental attitude through proper alignment and maintenance, on to proper operation in both normal and unusual operations, there are really not too many reasons to remain ignorant concering safe and proper operating methods. In many cases the real reason might be "forgetfulness" and in retrospect, the operator will remember being told how to perform the operation correctly or being warned that a certain procedure is definitely forbidden.

Although we might have chose, for demonstration any one of a number of tools, the table saw and jointer were chosen specifically because they are considered standard equipment in most industrial arts laboratories. I would now like to demonstrate, first on the table saw and second on the jointer, some of the major problems involving operator error when performing normal operations.

TABLE SAW DEMONSTRATION — re: Ripping
Cross Cutting
Dadoing

OPERATOR ERRORS	KICK BACK CAUSES
Reaching over	Fence alignment
Following the line	Saw teeth - set
No fence	Arbor alignment
No insert	Control - operator
Depth of dado	Healing
Play time	Depth of cut
Gum/Pitch/Dirt	

JOINTER DEMONSTRATION — re: Edge Jointing
Surface Planing
Rabbeting
Stop Jointing

OPERATOR ERRORS	KICK BACK CAUSES
Hand over cutterhead	Depth of cut
Not following the fence	Material off table
No push block	Dull knives
Guard removed	One knife high
Rear of cutter exposed	Control - operator
Loose controls	

I sincerely trust that this demonstration was both interesting and informative, as opposed to merely "talking the subject through." I am sure that in your particular laboratory or shop situation you could come up with a great many other typical errors in operation and/or causes of kick back, but these I have demonstrated are definitely universal

in nature. One or the other is almost always a part of any accident report or investigation.

I think it is obvious by this time that federal and state laws, in addition to your own specific rules and regulations, really will not solve the problem. Your personal demonstrations of proper operation, film and transparencies on this subject, student texts and operator cards are all major steps in the right direction. Undoubtedly better education is really the solution to this problem. Manufacturers, naturally, can help by providing various safe guards, both mechanical and electrical, and we are all continually striving to do a better job in this area. In fact, in many cases, manufacturers far surpass the requirements of either OSHA or the Bureau of Product Safety, or for that matter, UL. The mechanical and "cleanliness" condition of the unit involved, plus proper alignment, are also a definite factor in proper operating safety, and I think we have proved that here today.

Although everything and everyone can help, I firmly believe the industrial arts instructor or industrial education instructor is in the ideal position to improve or solve all three problem categories. The mental attitude of the operator is really the final key to success. In general, if he has read the instructions, knows the safe rules of operation involving that particular tool, keeps his mind on what he is doing and does not gamble, the chances of having an accident are practically nil.

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OSHA Inspections

David R. St. John

Since the passage of the Williams-Steiger Occupational Safety and Health Act[1] (OSHA) on December 29, 1970, there has been a growing concern about compliance with a set of federally induced standards. Considerable confusion exists as to who is covered and where the ultimate authority lies. While it is true that not every state has taken over the responsibilities for the enforcement of this law, it is apparent that our facilities are going to have to measure up to some set of standards. This means that inspections ultimately are going to occur.

WHAT CONSTITUTES AN INSPECTION?

Any time you walk through an area with the purpose of "looking for problem areas" could constitute a safety inspection. This however is not commonly thought of as conducting an inspection. Rivell[2] states that inspections in school shops may be classified as one of four types: (1) periodic inspections, (2) intermittent inspections, (3) continuous inspections and (4) special inspections. Since most of us have not established what we would consider a "sound safety program" in terms of occupational safety and health standards let us consider only the last of these inspection types for the moment. As our programs develop we will be able to plan for and utilize the other three types of inspections as part of an ongoing program of safety.

Special inspections are of several types. The special inspection we will address at this point might be thought of as an initiating inspection, a spring board, or a point of reference from which we can begin a conscious effort of upgrading our program.

WHO SHOULD CONDUCT AN INSPECTION?

While it is easy to recognize that the ultimate responsibility for inspecting school shops rests with the teacher in charge, it is equally as recognizable that he should not be considered the sole agent qualified to provide valid inspections. Supervisors, administrators, representatives from advisory committees and industrial safety engineers might be utilized as well as local fire inspectors and representatives of state and federal departments of labor.

Asking an industrial arts teacher who has been doing an excellent job of instructing to become solely responsible for inspecting a facility to meet OSHA standards without some inservice training would be somewhat presumptuous to say the least. In fact it would compare directly to the corporation who had employed a pilot to fly their single engine plane and then expect him to jump in and take the full responsibility for flying their new corporate jet without any specialized training. Even more ridiculous would be to criticize him for any inadequacies as he began the transition.

Several different approaches could be utilized to initiate a safety inspection procedure. Although many persons do not realize it the State Department of Labor — OSHA Division, in most states operates a voluntary compliance service. In this division many services are available. Among them, most states offer a service of voluntary compliance inspections where the employer whose facilities are being inspected is under no threat of citation for violations. The purpose of these services is to encourage voluntary compliance on the part of the employer. Only in cases of imminent danger would any violation ever be reported to the compliance divisions inspection teams for followup. This service is to be highly recommended even though most of these offices are being flooded with requests and it may take several months for them to be able to inspect your facilities.

The employment of industrial safety engineers, trained in the interpretation of OSHA standards is another viable alternative where time is of the essence. While the cost is a factor it should not be entirely discounted if your program needs immediate assistance in improving safety conditions.

WHAT SHOULD BE USED AS A REFERENCE?

With the current concern about OSHA several agencies have undertaken to analyze the most immediate concerns of employees and employers publishing a myriad of information concerning the implications for compliance with this new law. Among the extremely varied materials being published today many inspection forms can be found.

Educational Agencies are no exception to this sudden rush to publish in this field. State education departments, university departments of industrial education, and the various professional associations are all entering the picture. There is really nothing to be gained in questioning their motives for this rash of published materials. Even if it were true that their motives were all in the interest of improved safety, which very clearly is not the case in many instances, the materials which they are publishing are of very limited value to the individual teacher. Here is why...

The fact that only one reference can truly be used as a basis for establishing a safety inspection program should be obvious. In the case of school shops, the OSHA Horizontal Standards for General Industry are the standards referred to in the law. Any materials referring back to or attempting to interpret these standards must ultimately be based upon these standards, constantly refering back to the principle document itself. While many man-hours, most of them spent by persons very well acquainted with these standards, have been spent analyzing and interpreting these standards the fact remains that the standards are the ultimate source. The problem then is essentially this — any time that I might spend interpreting the standards and developing an inspection guide for you will only result in a condensation and interpretation of a very complex system for your use. To get the final authority on these standards I must ultimately refer you back to the standards.

There is no doubt that much of what has been published will be of such limited value as to be worthless. Though one can say that some of the inspection guides represent very good efforts and can be highly recommended. The inspection guides developed by Dr. Joe Luke and an extremely well qualified group of consultants for the Utah State Board of Education[3] is certainly to be ranked among the best. A reference is made on almost every inspection item to the federal (or state) standards. This provides the user the opportunity to reference corrections which may be needed. Another excellent reference has recently been published under the direction of Dr. John Bonfadini and a committee of instructors from Prince William County Public Schools in Virginia.[4] Still other resources, such as the draft copy "An Interpretation of OSHA for Industrial Education" prepared by the American Council of Industrial Arts Supervisors,[5] are excellent references on the whole topic of safety. However, in the final analysis the individual teacher must eventually become familiar with the standards themselves. The best way to do this is to secure a copy of the standards and set about a plan of detailed, section by section, study of their contents.

WHEN SHOULD INSPECTIONS BE CONDUCTED?

In an ongoing program it is difficult to decide when an inspection should be conc It is easy to accept the suggestion that the earliest possible time is probably th desirable as the inspection will serve as the springbord for progress in an overall program. This is, of course, based on the assumption that some provision has been to train the inspectors or to bring in qualified consultants.

A serious error would be made to request that every shop teacher pick up the "district form" and conduct an inspection during the next week of classes. In fac errors could occur. First, the assumption that each teacher would interpret the ir tion form properly is only an assumption and as such is probably incorrect. A inherent danger embodied in this same assumption lies in the probability that each of teachers and possibly the district coordinator would now assume that their insp responsibilities were completed. Second, it would be totally inappropriate to ask a te to be responsible for conducting an inspection in his own classroom while he was s taneously trying to teach his classes. It is very likely that when a teacher is insp his own shop he will be so familiar with his own equipment that he would not be a recognize all hazards or faults. In essence he will be so close to the forest it w difficult for him to see the trees.

It is strongly recommended, however, that the inspection be conducted while st are working at routine activities within the facility. This will bring to mind a num areas which would have to be assumed by the inspector in the absence of workers.

SUMMARY

In planning an approach to safety inspection of school facilities several recomm tions can be made. First, develop a schedule for regular inspection and followup will assure the coverage you wish to establish. This will do a lot more for you safety program than simply identifying violations. It will develop a safety consciou on the part of all teachers which is very valuable to the success of the total pro

Second, select a group of inspectors who are familiar with the standards. It m necessary to provide a series of training sessions to prepare for these inspections. will be time well spent if your inspe rs understand what they are looking for and to find information on corrections.

Third, do not ask a teacher to inspect his own facility while he has a simulta responsibility of teaching. This is like asking him to ride two horses at once. H not be able to do a good job with either responsibility.

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Special Needs Programs

Motivating the Disadvantaged and Handicapped in the Industrial Arts Environment

Chester R. Anderson

Motivation or motive: You, as teachers, should know the meaning of the words, but let me call to your attention the definition again: That which incites to action, having the power to move, causing action, to provide with a motive, instigate and induce.

Are you as teachers doing this? If not, you are not good teachers, and it is time that you must be held accountable.

If teachers are to motivate students so that they become motivated from within, it is imperative that teachers know what good teaching is. I would like to suggest the following:

1. Teaching yields a high sense of dedication to duty; it is a way of life with a sense of mission.
2. Teaching is directing learning, for learning depends upon the learner's intelligence and self-disciplineary efforts.
3. Teaching is the opening of windows to learning, and not the filling of containers. (Answer-ing a set of memorized questions to forget soon.)
4. Teaching is proceeding from the easy to the difficult, from the known to the unknown, from the concrete to the abstract.
5. Teaching is motivating, stimulating and inspiring young and old to discipline themselves in the total learning process.
6. Teaching helps the learner to observe, to detect problems and their solutions and to develop ideas.
7. The good teacher places a high premium on character and sets a good example at all times.
8. The good teacher reads to keep up with new materials in his field — the new technology — and is aware of social changes and the need for a positive feeling for another ethnic group or race.

I am sure you are the kind of teachers I am talking about, for if you are not, you should be released from your position immediately.

Because one has graduated from a large university or a college that has doubled its enrollment in six years does not necessarily mean that it has developed good teachers who can set up the environment to motivate students.

Motivation is not just taking education courses. When you are enrolled in Education 256, and the next semester you are required to take Education 260, and you have the same instructor, you perhaps will hear the same old corny jokes. The stimulant is gone when you walk into the classroom.

Many old heads are not going to change their lesson plans, tests, classroom structure, nor outlook on racial problems, and when I mention racial problems, I am speaking about Mexicans, Italians, Whites, Blacks, Reds, Yellows or whatever the mixture.

We must get rid of the teachers who motivate like the one who told me at Kansas State, Pittsburg, in 1930, that it was impossible for me to graduate from this school because I had an I.Q. of 80. I had not been on the campus for five days; I had not been given any tests. These same unmotivating teachers knew nothing of my background. I had finished the 8 grades in 7 years and had enough credits to graduate from high school in 3 years. I decided I would change and take a masters at Iowa State University, of which you had to be in the upper fourth of the graduating class to be accepted. I finished the masters and wrote a thesis, spending only 2-1/2 summers at the university.

We must get rid of teachers who motivate like the little lady English teacher did me at this college. The first day that I walked into class, she said: "We don't have any niggers in this class, and if you remain, you will flunk." I looked around; I did not see

any and sat down. I will tell you now, I am not a nigger. In teaching you must remember that your students want to be recognized, to be guided, to be creative, to belong and to be secure. You must remember you are preparing workers. You must increase their confidence, upgrade their competence by raising their earning potential.

We must motivate our youth so that they will know that success potential is obviously tied to maturity, and in particular to emotional maturity.

It is not easy to become a good motivation teacher, but here are some pointers:

Motivation By Objectives:

1. Your teaching will become more successful because your objectives provide you with greater flexibility.
2. Your students' effectiveness and productivity increases because they become more involved and committed to their work.
3. Your students' commitments and loyalty to your teaching increases because they see how they fit into the environment of the learning program.
4. Your product increases and your students become a more viable force in the world of work.

Motivation by objectives leaves nothing to chance. Step by step, it tells how to start, how to build three critical factors of involvement, participation and autonomy (right of self government).

— It is building student teamwork.

— It is concentrating your students' potential for more dynamic growth.

— It is unleashing your students to open up creative energy.

Someone has said: "A motivating teacher is a guy who can step on your toes without messing up your shoeshine."

The motivating teacher is one who does more than is necessary and keeps on doing it. The motivating teacher has two important characteristics: He is going somewhere, and he is able to persuade others, his students, to go with him.

The way to get a thing done is to stimulate competition. Competition is found in all industries — to develop and discover more. Motivation is never expecting a second chance to make a first good impression on your students.

People can be divided into three groups: Those who make things happen, those who watch things happen, and those who wonder what happened. What group are you in?

The most valuable gift you can give to anyone is a good example. Therefore, to start your motivation you, as a teacher, must be well groomed, dress appropriately and look the part of a teacher; set the example.

To motivate, teachers must be militant, not afraid to speak out, but in speaking out, do something constructive concerning your teaching and criticize the administration; you know we need things changed in our educational system. See that it is accomplished. Work for flexible scheduling, open entry, open exit, staggered class time for individual students.

How can anyone really motivate positively when he writes an article titled: "Need: A New Kind of Slum School?" The educator who wrote the article is downgrading those people who live there. Why emphasize slum? This is the place where the student lives; it is home. The above statement leads me into my next discussion. No motivating teacher will ever use the words disadvantaged, hard core, culturally deprived, or poor. If these are used, we are defeating at the beginning what we are professing to do.

These are unmotivating names. Any time you speak of me using these terms, of which none apply to me unless all apply to you, then you are referring to me as inferior to another. Should you continue this from my early childhood, and I did not have the drive that one needs to overcome, we would be compelled to call this reverse motivation: I will soon believe I am nothing. This is what we believe the terms are used to portray.

The following is a reprint by a Ford Foundation from the Record, Teachers College, Columbia University, November 1967, with the title "Taking Advantage of the Disadvantaged" by Mario D. Fantini and Gerald Weinstein.

But we will really not have followed this lead and revitalized education until we face up to some fundamental propositions;

- That all American children are educationally disadvantaged.
- That despite the advance of educational activity and the surge of additional money we are still in the business of repairing an anachronistic machine, an error in chronology.

- That we are laboring to serve the needs of academic subjects, not the needs of children. No difference in technical and academic.
- That there is less wrong with the learner (the product of education) than with the process and institutions by which he is taught.
- That "good schools" should be defined not by their racial composition, but by the quality of what happens in the school.

I must ask again, why say they are poor or call them poor? He knows he is poor. He knows he is hungry. Therefore, I am asking you to forget those terms and just call them people — people who need help, people who need someone to care. A person who cares will proceed to develop some way to motivate, even if it is only to teach the youth to turn off unneeded lights, close the windows, to conserve energy. There may be a carryover from school to home and, when employed, to the job.

Motivation in my class meant this: When a new student came into the classroom, who went over to greet him? My position was to remain in the background. My students would greet the new student and start her off by giving her a work station and making the assignment. I would stop by and become acquainted later, first having a conference with the student's beginning teacher to decide when it was best for me to make the approach: But don't you ever believe that at any time I did not know what was being done in that classroom.

My students were reminded constantly that they were as able as any other person, with the same opportunity, native ability, and a desire to learn.

Motivation is flexible scheduling, staggered time scheduling for special needs of the individual. It is working with the individual, having individualized programs so one can proceed at his own speed.

Motivation is treating all students fairly. If you cannot look at your students and not see Blacks, Whites, Mexicans, Italians, or Indians, you have failed. You are sick, you need a doctor.

Motivation is working with the individual and the group, developing the awareness of doing things differently, changing day-to-day classroom procedures.

Motivation means communicating with the students through the ears, eyes, body, feet, and voice. Remember you are a photograph, and they can read you well.

Motivation is using the method of students helping to teach. Many times they can do this better than you.

The drop-outs must be motivated. Talk with them. You may need to dress as they dress, and you should. You may need to get them a beer or learn to talk and understand their jargon. Don't be "Mr. Know It All" because first you won't get any answers, and secondly you don't know it all. You could not survive in the places in which these youth have lived. You as teachers must be a part of the decision-making in curriculum development. You are the closest to the student, and you know his needs. Let your students know you had a part in that decision.

Let your administration know that you are going to have a part in the development of the curriculum, whether they like it or not.

The motivating teacher will develop a communication line with the English, mathematics, science, or other teachers whenever one of his students is having difficulties in another class. You can do a great deal for your student, and in time for those teachers.

The motivating teacher, I must reiterate, will never look at a student and think disadvantaged, hard core, deprived, ghetto child, or underprivileged. These identifying terms must go. Society, which is you, is crushing these prople. Society is cruel, the man with two faces.

To do the job with your students, you must love them, take an interest in them, listen to their problems, even those who don't use what you may call proper English or refined speech. You may hear what you believe to be "harsh language," "four-letter words." Remember, this is what the student knows and has constantly heard.

I would like to read an excerpt from Michael Foster's college application. Michael is a black boy. The question to Michael: "Have you ever accomplished anything which you consider praticularly noteworthy?" His answer: "I taught my mentally retarded cousin how to tell time after his teacher and doctor said he would never understand anything so complex."

We talk about those lazy Indians. Mrs. Anderson and I spent a summer in Arizona with the Apache and three years later spent the summer with the Hopi Indians. These

Indians were there on the hot desert land that had been given to them by our government. The worst land in the country — and they owned this whole nation. These people did a hell of a job keeping America beautiful before the American came. There was no pollution problem; they only used what they needed. Energy was conserved. Does the hot desert motivate you, besides wanting to get out of it?

Do we tell our students that the Indians did many good things besides losing all of the battles — like saving many pilgrims from starving?

Our motivation of students should tell them of the unmatched civilization of the Maya Indian of Southern Mexico, who had built great temples, government buildings, towns, and cities, developed the most accurate calendar of today, were most knowledgeable concerning the planets. Their civilization lasted for more than 1000 years. They had a very sophisticated written language. All of this has been documented and was presented on channel 19 & 13 on April 1, 1974. These people were far ahead in architecture, construction, planning, and organizing successful government long before the Spanish or Columbus ever set foot on this land. In fact, this was around 300 A.D. Such information can be a motivating force for your students, if you will use it wisely.

The good teacher will introduce into the thinking of his students the fact that the educational and dislocation problems which frustrate society are not only non-white problems.

Teachers must be sensitive to each individual in the class. They must use a different approach with each individual, for each student is different.

The motivating teacher is a hard worker, an advisor, psychologist, clergyman, expert in human relations, father, mother, brother, sister, and a friend to his students. He works long hours, generally without overtime payment, and is on call at any time of the day or night. His students will know this.

You, the teachers, are the ones to help the youth acquire a meaningful outlook on life by giving them an opportunity to learn a skill and receive a salary for their work. You are an image, a motivator.

There is nothing more meaningful to youth than honest economic success previously considered unattainable.

A lack of motivation is a key factor in the tragic dropout rate among our youth. They must see an example, an image.

To help motivate your student you must determine if anyone requires assistance in one of three areas:

1. He may need a job to be able to stay in school.
2. He may need tutorial assistance to keep up with his school subjects.
3. He may have a very low opinion of himself, and therefore, the first need is to build a positive outlook by talking to the youth, listening to what he has to say; you will be able to ascertain what are the reasons for failure. He will change and believe someone cares.

You may be the person to cause an awakening of the youth who asks himself, "Why should I steal a $5.00 hub cap against having a $5,000.00 job?" Some of the youth you teach think that no matter what they do in life, they will never be able to get a good job. With your help, love, interest, advice and guidance, someone is going to say, "I got my first job through the effort of my teacher."

A negative self-image is a detrimental factor in the psychological make-up of any individual, regardless of his ethnic group. The recurrence of failure of our youth has created a vicious cycle of poverty, unemployment and a lack of confidence of the public who pass the levies in our cities.

The teacher's attitude and resulting behavior can alienate a child from school. The motivator will not contribute to the dehumanizing factors of discrimination, prejudice, stereotyping and emasculation that take their toll of many American youth. For these individuals, self-realization becomes resignation to mediocrity. This is the phenomenon of the "oppressed seeing himself through the depressor's eyes."

We as teachers must motivate our youth so they can see a future; then the bond of failure can be broken.

Many of our students' parents will say, in the presence of their children, "I am not proud of my life, but maybe my story will help someone out there, who thinks it's too late. When you have been at the bottom of hell for half of your life, it's almost impossible to believe there is sunlight anywhere."

Whether you believe it or not, our society is responsible for whatever happens in a

munity. Our society condones it. Our society perpetuates the condition of hunger, housing, poor education for minorities, by not communicating with students in the classroom.

The motivated teacher will know that the black child, the poor white child, is a learner. will to learn burns in him. How and what he learns has been out of his control. It been in the hands of the educators. These youth want to achieve. They want to become determinating, self-sufficient, have self-respect and self-defense. Your students be some of the ones who wake up in the morning and NOT have a glass of milk, and bacon, as you have.

Then you greet these students as though they were untouchables. These youth cannot as calm as you, or think as you think, for they have seen this problem of want from time they were born. Some of these children have been living in these conditions not days, weeks, or months, but for a lifetime.

If any of you teachers would live in these conditions for only two weeks, you would er be the same again. The motivated teacher will have compassion for these children, love them, and will put his arms around them. The teacher who cannot do this has business teaching.

It seems to me that the interaction of the teacher and his students is the key to a dent's success. His tone of voice, facial expression, touch and posture may be the ans by which, probably quite unwittingly, he communicates his expectations to the dent. Such communication will help the child by changing his conception of his cognive skills.

As teachers, in listening to Black speech, you assume that the use of non-standard English is an example of bad grammar, without recognizing the possibility that we ack people) have a valid, legitimate, and alternate dialect.

Possibly, if teachers would stop trying to compensate for the so-called weakness of Black student and try to CAPITALIZE ON HIS STRENGTHS, the teaching could be re productive.

The teacher who wishes to motivate his students is not satisfied with the one or two dents he is reaching in his class, but recognizes the impending tragedy for the 18 or students he is not reaching. This teacher will really work to strengthen the student's acity to choose intelligently and independently and to determine what it is he seeks to rn. He will help the student to find meaning for himself in his studies.

The motivated teacher will know that there is no difference between the white person the black person if the background environment is similar.

Any teacher who can motivate students knows he cannot be the classroom autocrat, ing students are still immature, etc., for he is rarely a match for his students.

Motivated teachers will have a definite conception of what they want to teach and see that the students must be equally resolved as to what they should learn.

The good teacher who induces learning WILL NOT CLOSE OUT THE FEEDBACK OM STUDENTS. Teachers and educators can and do operate for years without knowing it failures they are in the eyes of their former students.

To motivate students we must involve them in business' and industry's know-how. We st involve them in the problems of society.

Innovation is a must to successful motivation. It is hard work, but it is most pleasing ou are determined to be a dedicated teacher.

- *There must be individualized instruction or teaching.
- *There must be programmed instruction.
- *Your test must be for the individual when there is readiness for the test materials.
- *Lectures must be developed on tapes for the individual or for a group, when the need arises.
- *Develop color slides and place the information on these slides; you have 35 seconds for sound information on a disc for each slide. Then the information can be up-dated whenever there is a need by just reusing the disc. The slides can be up-dated also.
- *Involve the student in the making of the slides and in developing information.
- *Let students develop filmstrips so that the materials will be in their language and they can see now, why and when they had a part in what has been accomplished.
- *Develop rapport with the English and mathematics teachers so as to have the students write their themes around electronics, drafting, speech, or any subject that holds a real interest for them. Then have the mathematics and electronics teacher,

together with the English teacher, correct the student's theme.
*Allow your students to correct each other's work and discuss it with the student or group, then discuss it with the teacher. After this procedure, the teacher and the entire group could have a discussion.
*There must be planning conferences with students.
*Let each student know that what he is doing is directly related to everything that goes on in a specific class.
*Allow your students to participate in a candid evaluation about you and the course of instruction after he has completed the course work and the grade has been recorded. These papers need not be signed.
*You are the teacher — stick your neck out. Conformity is too comfortable.
*Take the student where he is in the learning process.
*You will influence others no matter what you do.
*Tell others to change from viewing minorities, especially Blacks, as inherently incompetent.
*Motivation is being creative and not being afraid of looking bad.
*The aim of good teaching is to become unnecessary to the upward thrust of the motivated student.
*There is a better way to transmit information than by the lecture-mouth method. Let the student do it.
*Motivation is preparation of materials for different levels. You cannot always keep a group of students together. It is poor teaching.
*Incite men and women to prepare for any job. There must not be any jobs that are called men's jobs or women's jobs.
*Teach the very small girl to play with a tractor, truck, oil the lawn mower, as well as play with dolls. The same goes for the boy.
*Learn some of the language of any ethnic group that you are teaching. The special-needs youth can succeed in your classes if you will:

1. Be sensitive to the youth's life style.
2. Develop a communication system with parent, facing needs truthfully and directly.
3. Adjust the teaching style to the learner's needs.
4. Take the student where he is
5. Relate teaching materials to the youth's life style.
6. Correlate what the student learns to the demands of the world of work.
7. Stress the concrete and word for word rather than the theoretical and abstract.
8. Analyze each instructional unit down to its simplest form.
9. Keep an open mind, alert to moods and attitudes, providing the student with an opportunity to talk out frustrations and misunderstandings.
10. Design the instructions so the student can see some evidence of success, remembering not to underestimate his/her potential.
11. You must begin instruction at the student's level and keep him/her motivated, developing his/her potential at a pace that challenges but does not discourage him/her.

Let me direct our attention first of all to the mentally impaired, or more specifically the Educable Mentally Retarded (EMR's). It is important to recognize that the mentally impaired student has the same needs as all other youth:

1. To be loved.
2. To receive instructions for independence and responsibility.
3. To be encouraged and disciplined.
4. To have experiences with a variety of people and be exposed to many places and things.
5. To be understood and supported by parents, teachers and the community.
6. To have the opportunity to succeed and the right to make their own mistakes in everyday situations.

In conclusion, remember that in order for people to be equal to other people of the world, it is required that they be able to communicate information, explore new ideas, and discover the many options that exist in life. The cruelest thing we do to people when we don't educate them properly is to restrict their options, their knowledge of what they might have been or might be.

Mr. Anderson works for the Kansas City, Mo., School District.

A Practical Approach to Work Adjustment Training for Handicapped High Schoolers[1]

David N. Kelsey

At a recent planning conference, President Ford was disturbed to find that there are 28 million handicapped adults in this country, and only 800,000 are currently employed. Of those employed many work at tasks well below their ability.[2]

The figures are sad testimony to the reality that traditional secondary educational programs have not lead to continued gainful employment for a significant number of handicapped individuals. The facts are: (1) that vocational education programs largely have excluded handicapped students and (2) that more handicapped employees fail in job settings due to poor work adjustment attributes than lack of job skills.

This paper introduces a model for work adjustment and outlines a program that has been used to integrate handicapped high schoolers in secondary vocational settings with an added emphasis on work adjustment training. Thus, the program attempts to resolve the above two problems.

THE MODEL

Work adjustment is defined as the level of satisfaction experienced by employees and/or employers when individual workers are placed on particular jobs. The major goal of work adjustment training is to increase the level of work adjustment to optimal values for both employees and employers.

In attempting to improve the level of vocational/occupational functioning of individuals there are at least four sets of attributes which are commonly encountered. These four sets of attributes can be considered as predictor variables and are presented pictorially in the General Model for Work Adjustment.[3]

The attributes related to persons are:

1. The worker's job related skills, his personal strengths and weaknesses.
2. The worker's psychological adjustment to work.

The attributes related to jobs are:

1. The actual physical skills and cognitive requirements of particular jobs.
2. *The characteristics of jobs and job environments which act as either positive or negative reinforcers for workers holding those jobs.*

The four sets of attributes interact to influence the level of work adjustment of individual workers. It is the interaction between the predictor variables that will produce the ultimate level of work adjustment between the worker and his job. It is important to note that in the vocational/occupational training of handicapped workers any one predictor variable may have a disproportionate influence. This frequently requires that special attention be given to the design and implementation of an individualized formal work adjustment training plan for this handicapped individual. Later in this paper the interaction between the four predictor variables which produce given levels of work adjustment will be examined in greater depth.

The first predictor variable, worker skills, continues to be the mainstay of vocational/occupational education. Work evaluation is the term generally used to refer to the process of assessing and describing the work skills, achievement, general health, motor development, sensory acuity, communication skills and other work related levels of personal development which the learner or worker brings to the evaluation site. Formal measures might include the Purdue Pegboard, the General Aptitude Test Battery (GATB), and a host of mechanical aptitude tests. Informal measures could include such things as work samples, job samples and situational assessment.

It is recognized that work evaluation is a process that most vocational/occupational teachers have been practicing for years. With regard to handicapped learners, however, what is needed is a level of work evaluation that more accurately describes those abilities and limitations which impinge on the future success of the handicapped learner. Informal evaluation may need to be more formal and more frequent. Formal evaluation may require additional professional help to administer special diagnostic tests. This additional professional help may also advise and counsel the vocational/occupational teacher with regard to understanding the disability. To improve the work adjustment of the individual, worker skills may be a predictor variable that needs a new and better emphasis.

The second predictor variable, psychological adjustment to work, refers to the collection of attitudes, habits, self-concepts and feelings which an individual habitually exhibits toward work and jobs. It includes a generalized perception of his own relationship to employment and to the world of work. Handicapped learners frequently exhibit poor attitudes, bad work habits, inadequate concepts of their own work potential and general feelings of inferiority. These are due, in part, to their history of failure and rejection. Distinct behavioral cycles are frequently observed among handicapped learners. The cycle begins with a failure at some activity or task which has some importance for the learner and his peers. The failure produces anxiety over the consequences of future failures at similar tasks. To defend himself against the possibility of future failures the learner may withdraw, feign illness, or become rebellious and aggressive. These defense mechanisms create new failures which in turn produce more anxiety. By the time a boy or girl reaches high school the effects of such behavioral cycles may be quite pronounced. Like most human behavior, psychological adjustment to work is amenable to modification over a period of time.

Among the formal measures that can be used to analyze the psychological adjustment to work are the Work Values Inventory and the Ohio Vocational Interest Survey. Informal measures could include interviews, conferences with special education and guidance personnel, and observation with anecdotal records.

These formal and informal measurement techniques will allow the teacher to identify those habitual behavioral tendencies that the learner demonstrates toward work. The sum total of these tendencies and the learner's generalized perception of his own personal relationship to the world of work can be defined as his work personality. Again, where research has been conducted into the causes of job failure of handicapped individuals, it is clear that the major cause is inadequate work personalities and not the lack of work skills.

Making planned modifications in the way a handicapped learner thinks, feels, or acts toward work is the major goal of work adjustment training programs. Psychological adjustment to work has been an important variable largely neglected in vocational/occupational programs.

The third variable in the model is the physical and cognitive requirements of jobs.

The systematic study of jobs and occupations with the objective of identifying and describing work skills and cognitive skills used by workers in these fields is referred to as job analysis. For purposes of this paper, job skills and work skills can be considered synonymous. When considering handicapped workers it is not safe, however, to consider cognitive skills and related technical information as interchangeable. For example, a mentally retarded worker may be employed to grease automobiles in a filling station or garage. A job analysis would inform us that two of the work skills needed by the employee would be: (1) how to use the garage lift to raise and lower cars, and (2) how to use the grease gun to apply grease to the various fittings on cars. Related technical information identified during the same job analysis would suggest that the worker should know the differences between wheel-bearing grease and multipurpose grease. Such technical distinctions are routinely taught as part of related instruction in vocational/occupational education programs using ordinary teaching methods and materials. But this methodology may not produce the desired results with a mentally retarded worker or student. It is very likely that the retarded worker or student is a poor reader. He therefore is deficient in a cognitive skill which would not be considered as part of the related technical information associated with a job. Nevertheless, the lack of reading skill would be a contributing factor in the worker's difficulty in acquiring related technical information. Vocational/occupational education programs for handicapped learners need to reflect this broader aspect of related technical information. Job analysis and the instruction that is an outgrowth of the analysis may need to reflect a sensitivity to the cognitive skill needs of the job in addition to work skills and related technical information. If the vocational teacher does not play a part in improving these peripheral cognitive skills, the job may not get done.

The formal analysis of many jobs has been accomplished and the results are available for use by vocational/occupational educators and others. Publications such as the Dictionary of Occupational Titles, Estimates of Worker Trait Requirements for 4000 Jobs, and Jobs for the Mentally Retarded are all standard works which will be helpful if consulted.

The ability to do job analysis is included in the repertoire of skills that most vocational

achers possess. The type of job analysis needed, however, is one that is flexible enough allow for and even to anticipate the presence of handicapping conditions in vocational/ cupational students if high levels of work adjustment are to result from instruction.

The final predictor variable included in the Model is job reinforcers. Job reinforcers efers to the attributes of jobs which serve as either positive or negative reinforcers of arious work behaviors of employees. Although the ability to perform a particular job kill or cognitive skill may easily be the most significant reinforcer for a worker, it is ot that reinforcer which is of primary concern in a discussion of job reinforcers as a redictor of work adjustment. With reference to work adjustment, the job reinforcers hich are of primary concern are the ones which are characteristic of the job and which einforce work behaviors. Such reinforcers as pay scale, physical work conditions, ttributes of supervisory personnel, kinds and amounts of fringe benefits, location of job ite, transportation to and from work, congeniality of work associates, steadiness of work, ocial status of the job and many others are frequently of crucial importance in the total ork adjustment of employees.

The identification and description of a job's reinforcers for the student along with elective modification of reinforcers and/or the matching of reinforcers with the psychogical adjustment traits of the student has great potential for improving the level of work djustment.

PPLICATION OF THE MODEL

The Model for Work Adjustment would suggest that if a teacher, or other worker in e field would modify the content of any of the four profiles, there would always be a orresponding change in the level of general work adjustment of the individual.

An example of the practicality of the model may clarify its intended purpose. In ngland, researchers who were investigating the high rate of employment turnover among oal miners found, after months of study, that the most important single factor causing e low level of work adjustment among the group of miners who voluntarily terminated eir employment was the travel time they lost going to and from work. Not the distance aveled; but, the time in transit. They found (approximately) that if the travel time of ne group of men to work compared to another is doubled, then, the loss rate per year of e group that travels the farthest is also doubled. If the time difference is tripled, the ss is also tripled.[4]

This is a clear example of the job satisfaction of workers being diminished by the ction of a negative job reinforcer. As the worker's time in transit increased, job satisction decreased. Reduced job satiffaction and its resultant reduction of level of work djustment ultimately caused many coal miners to leave their jobs, where they were therwise well adjusted, and seek other forms of work.

An explanation of this British research in terms of the model for work adjustment ill serve an instructive purpose.

When the researchers systematically extended the travel time of the coal miners ey were, in effect, increasing the degree of negative reinforcement of one of the imporint job reinforcers associated with being a coal miner. By so doing, they reduced the ongruence between the miner's psychological adjustment to work and the job reinforcers. n analysis of the research data brought to light the fact that the degree of mismatch etween the job reinforcer time in travel, and the psychological adjustment to work was irectly proportional to the turnover rate of voluntarily terminated miners.

When the travel time of the miners was reduced by the practical expedient of changing e railroad time schedules, which cost the mine owners nothing, the turnover rate was rastically reduced. Further reductions were effected by building company housing units ose to the mines.

In this country, there is evidence of widespread discontent among workers. Boredom ith jobs and poor attitude syndromes seem common. Industrial giants such as Ford, GM, M, Allis Chalmers and General Foods are taking the lead to modify the attributes of eir jobs. At GM small teams of workers are building motor homes from the hubcap up istead of the traditional assembly line. Workers are required to use a wider variety of eir work skills to build the entire coach. Elsewhere, in Topeka, Kans., the Gaines Pet ood Plant has established a system whereby the rewarding and unrewarding jobs are qually shared. Teams of workers also interview and hire their own replacements.[5]

The examples give dramatic credence to the assumption that it is sometimes as easy

to bring about improved employee satisfaction by changing the job as it is to change the worker. Frequently vocational/occupational educators, and others, spend inordinate amounts of time and other valuable resources in changing the attributes of persons when the same objectives can be reached by changing the job or job environment. Frequently this strategy results, as it did with the miners, in reduced costs and added benefits to the learner.

These documented examples were chosen because of the results they have had and because they are applications of the Model for Work Adjustment. Recognize, however, that these are cases of work redesign. Some researchers argue that changing the job is not the answer — change the people.[6] They are finding psychological adjustment to work can be modified.

Due note should be taken that according to the model improved work adjustment can be the result of changing the characteristics of the people or the job. In some industries, Skinner's Theories of positive reinforcement are being used to modify attitudes toward work. Supervisory personnel are taught to look for and accentuate the positive work behaviors of employees through praise and recognition.[7] Clearly, this is a case of modifying the job reinforcer, attributes of supervisory personnel, with the long term goal of modifying the individual's psychological adjustment to work.

The professional practitioner in the field of vocational/occupational education should not lose sight of the fact that the goal of all vocational education is successful work adjustment. This is true regardless of the degree of handicap of the learner, or the menial character of the employment for which he is destined. As we have seen, the means to arrive at that goal can be modifying any or all of the predictor variables.

THE SHOP AS A LOCATION FOR WORK ADJUSTMENT TRAINING

It is apparent that work adjustment should be included as a part of the program for handicapped youth and adults. It is equally apparent that one of the best educational settings for training in the psychological adjustment to work to take place in is a vocational/occupational laboratory. Consider, for instance, that:

1. Skills, traits, and attitudes which are rewarded in an acader c classroom are not necessarily the same ones needed on a job.
2. It is sometimes difficult to transfer acceptable academic behaviors into successful work adjustment.
3. It is easier to teach behaviors such as dependability, accuracy, attention to job details, acceptance of supervision, persistence and others in shop settings where these behaviors result in the reinforcement of immediate job success than it is in classrooms.
4. Where meaningful productive activity is going on it is easier to motivate learners than it is in a classroom.
5. It is much easier to provide for the individual differences of persons with wide variations in skill and ability in shops than in classrooms. It is not intended that the shop or laboratory replace the classroom.

Good educational programs for handicapped high schoolers require a balance between classroom and laboratory activities. The point of the above is that the psychological adjustment to work is best enhanced while the learner is engaged in the kind of work activities he will be doing later on in the job, and that the reinforcement comes at appropriate times from a person who consciously knows what is being reinforced.

Gellman's research into the components of vocational adjustment may be used as a model in developing shop experiences which are intended, among other things, to promote the development of adequate work adjustment skills in handicapped learners.[8]

Shop experiences, where the handicapped learner is successful, will:

1. help to improve the learner's attitude about his own work potential;
2. help the learner to see that his contribution is meaningful and important even if it is
3. help the learner to see the importance of working as a member of a group, especially if the shop activity is production oriented;
4. help the learner to accept supervision and to view supervision as a necessary service;
5. help the learner to meet deadlines, to keep up with others, and to work under varyi degrees of pressure;

6. help the learner to understand the idea of career education and possible career options he might realistically expect to follow for himself;
7. help the learner to accept handicaps which cannot be totally eliminated.

Almost any vocational school shop or laboratory activity can be designed in such a way that opportunities are made available for handicapped students to grow and develop in the work adjustment areas listed above. A guideline which may be followed is: MODIFY THE TASK AS MUCH AS NECESSARY SO THAT THE HANDICAPPED LEARNER MAY EXPERIENCE SUCCESS. Some actual examples of the utilization of this strategy follow:

1. In an ornamental horticulture class where there were retarded students enrolled, the teacher might require the student to;
   a. operate a fertilizer spreader,
   b. prune shrubbery after appropriate instruction,
   c. start, operate, stop and clean a power lawn mower,

   But Would Not, At Least in the Beginning:
   a. ask a retardate to compute the amount of fertilizer to use on a yard,
   b. let the retardate decide which shrubs to prune,
   c. let the retardate decide which of several grass cutting machines would be appropriate for given grass cutting applications,

2. In a vocational home economics program which included mentally retarded students, the teacher might require the student to:
   a. clear tables, scrape plates, operate a dishwashing machine and dry and stack dishes,
   b. clean vegetables, cut them up and make them into a tossed salad,
   c. set tables,

   But Would Not, At Least At First:
   a. ask the student to select which of several detergents to purchase for use in the dishwasher,
   b. ask the student to find a recipe for tossed salad and adjust it for the number of guests expected,
   c. ask the student to set tables without a model to go by.

It may be observed that the above examples are representative of vocational education activities which would result in more than one kind of growth in the handicapped learner. Activities such as those cited would normally result in an improved psychological adjustment to work on the part of the learner, but, they would also result in the acquisition of certain low level job skills which would become saleable by the learner at a later date.

If the handicapped learner in the vocational/occupational program does not experience satisfying, successful work activity in the shop or laboratory then, he may reject the shop activity as he has probably already rejected the academic classroom. Successful achievement as a result of carefully selected learning activities and enhanced by teacher reinforcement may be the most powerful modifier of work adjustment attributes at the disposal of the vocational/occupational educator.

IMPLEMENTING WORK ADJUSTMENT TRAINING

Work adjustment training plans are not written for every student in the vocational class. The burden of time and effort for such a task would be prohibitive. Work adjustment training plans are, however, required for special needs students because patterns of unusual discrepancies between the attitudes and/or abilities of handicapped learners and the requirements of many jobs have been identified. Problem areas for handicapped workers, to name just a few, might center around such things as poor attitudes toward work, physical impairments, and/or cognitive limitations. Problems such as these usually are not dealt with in the normal pattern of moving from beginning abilities to full employability.

While the teacher cannot write a formal work adjustment plan for each student in the class, the process of implementing such a plan for a handicapped learner may have a ripple effect that is desirable. It is anticipated that the work adjustment training process for a few students may result in a heightened sensitivity on the part of the vocational teacher to the work adjustment needs of many students within the group. A gradual evolution

to regular teaching units that have work adjustment as the central objective seems a likely possibility.

The work adjustment training plan for each handicapped learner is one part of an individually planned vocational program. The vocational/occupational teacher should formulate the plan with the assistance of special education and guidance personnel. If necessary, these special personnel may also assist in the actual implementation of the plan by such activities as tutoring, interpreting (for the deaf), creating or reorganizing special learning materials and providing individual assistance as required.

A variety of training plan formats exist. To meet the needs of the program presented in this paper, the Illinois State University Vocational/Occupational Education Work Adjustment Training Plan Sheet was developed.[9] To facilitate the identification of the discrepancies between the requirements of a job and the abilities of a learner, the ISU Informal Vocational Learner Behavior Task Rating Scale (hereafter referred to as the Rating Scale) also was developed.[10]

The whole process of work adjustment training hinges on the willingness of vocational/occupational teachers to accept handicapped learners in vocational programs; but acceptance alone is not enough. The commitment must be there to do a better job of evaluating and meeting the individual needs of the learner to promote success.

The evaluative process includes the use of both formal and informal measures. Frequent conferences or close contact between special education personnel and the vocational/occupational teacher will usually be required. A primary objective of an early conference must be to establish the likelihood of success for the handicapped learner at some given level on the career ladder. The early conference also should consider the professional commitment to the success of this future worker; i.e., "What is my role; what is your role?"

With information sharing conferences, observation of the student, and the use of other formal and informal measures, the vocational/occupational teacher will soon find himself well equipped to begin effectively dealing with the handicapped learner.

Having gathered his basic data by the methods stated above, the teacher is ready to use the Rating Scale. The Rating Scale includes 96 items that cause the teacher to compare the requirements of a job with the abilities of the student. Items that reveal discrepancies between the requirements of the job and the abilities of the learner become the focus of the work adjustment training plan.

The final section of the Training Plan Sheet allows the teacher to systematically evaluate and record the progress of the student toward employability. When all discrepancies identified by the Rating Scale have been resolved through training plans and the student is checked (✓) employable for each objective, the teacher knows this handicapped learner is as employable as any student in the class.

Work adjustment training moves forward from objective to objective so long as the learner continues to make the desired kinds of progress. When the learner fails the teacher must look at the objectives, the content of instruction, the teaching method and the evaluation techniques to determine the cause of failure. This revisitation should be the source of new instructional avenues. Thus, work adjustment training is interactive; i.e., what happens in one situation influences what must happen in the following situation.

Any model for work adjustment training must consider the interactive nature of the process. The concept of reevaluating and reteaching until competency is demonstrated is important. If success in the chosen vocation hinges on work adjustment training then work adjustment training must hinge on demonstrated success at achieving objectives consistent with the chosen vocation.

FOOTNOTES

1. The ideas presented in this paper were an outgrowth of a DVTE funded project at Illinois State University. Team members included Dr. Robert Hemenway, Project Director; Dr. David Kelsey; Mr. Frederick Noyes and Dr. Samuel Price.

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Industrial Arts in Special Education

Dale H. Messerschmidt

In looking back some 15 years at industrial arts literature and comparing it with topics presented at the current convention, it is evident that industrial arts has changed. Recall, if you will, literature from the Sputnik era and the problems we raced in trying to attract quality students to industrial arts. We did things such as change the name Metal Shop I to Metals in the Space Age. We stopped calling the facilities shops and began calling them laboratories. Perhaps some of the changes were for cosmetic purposes, but our curricular changes demonstrate that many programs actually did change. Currently, you will note this convention's attentions placed on industrial arts for handicapped and disadvantaged students.

Recently public schools have assumed responsibility for educating the child with problems. Previously families with problem children were able, or even required, to keep the children from the mainstreams of life. Prior to the Kennedy administration attention began being focused on handicapped students, and then during the Kennedy administration monies began to shift to the education of handicapped and disadvantaged students. Today, it is safe to say, most school districts provide some program or facility to educate handicapped children. To illustrate the changing emphasis in education for special children, the U.S. Office of Education reported approximately 442,000 students enrolled in special education in 1948. By 1963 more than 1-1/2 million were enrolled. And it was projected that by 1968, 35 percent of those in need of special education would actually be enrolled in programs. Recently Dr. Frank Broullet, Washington's superintendent of public instruction, reported that 12.6 percent of all first graders in the state of Washington were found to have learning disabilities. That figure, 12.6 percent, is based on enrollments for the 1975-76 academic year.

In looking ahead at the role of industrial arts in special education, we must keep in mind several factors. To begin, the organization, capabilities and influences of our society will continue to produce defective children and/or children with problems. While it is indeed correct that medical technology has produced the capability to test for a defective fetus, parents with a high probability of birth defect are not obtaining the medical advice. Some writers predict that by the turn of the century we may have as many as 11 percent of our children being born with birth defects. Medical technology is now capable of keeping alive many birth defective children who would have died in an earlier period. These children will enter educational facilities of one type or another, and once entered in school, industrial arts has a role to play. It was stated earlier that social influences will contribute to problem children for the schools. I refer specifically to children born of parents who are drug abusers, and children born into unstable family situations. We must educate these children also. What and how to teach special education in the industrial arts facilities is the question.

The literature in special education is replete with pro and con discussions on the organization of physical facilities for special education students. While I really do not want to get overly concerned with the arguments of a specific building for special education versus a specific room within the regular classroom building, I do believe we should view the facility topic in terms of industrial arts for handicapped children. Just how important is industrial arts in special education? Perhaps your answer to that question will help you decide what opportunities and facilities should be available to special education students. Yes, we can have a self contained special education classroom. But we can have also an industrial arts laboratory available for full time instruction to special education. Let us now look at some of the handicaps which special education students possess.

STUDENT HANDICAPS

For purposes of categorizing special education students, we list two levels of retardation – mild and severe. We list also two levels for each of the sensory handicaps – partially sighted and blind, and hard of hearing and deaf. Then we list those with orthopedic and gross motor problems, neurologically impairments, emotional disturbances, learning disabilities and multiple handicaps. The program in which I participate includes students in all the above categories with the exception of blindness. The only reason there are no blind students in the shop is because the school has no blind students in the secondary level.

What do we attempt to do with special education students in industrial arts? The answer is relatively simple. We attempt to fulfill the usual goals stated for industrial arts. And we also attempt additional goals. Our primary objective is to return all students, who are capable of handling the work, to the regular secondary school. To obtain the goal, our staff, six secondary teachers, meets twice weekly to discuss a student's record, his or her learning problems and where possible to prescribe a series of activities which will lead to amelioration of the specific problem. For example, a student having difficulty in mathematics may benefit greatly from industrial arts participation because we can work on addition, subtraction, multiplication, and division of whole numbers and fractions. In addition, the industrial arts teacher can take a minute or two each day to drill students on multiplication, addition and subtraction. Undoubtedly, the student inadvertently learns a great deal of arithmetic during his layout activities.

The student with social emotional problems is, to this teacher, a greater challenge than the student with only academic deficiencies. For example, we recently took on one case where the child was kicked out of three different schools. The child kicked a principal, knocked a teacher's glasses on the floor and stepped on them, created general disturbances in the classrooms, and had a history of running away. Although the child is only nine years of age, he is permitted in the shop on a reward basis. When he completes his classroom work and behaves himself, we grant him twenty minutes of shop time. This child is bright and a prime example of how the association and identification with shop activities leads to a lessening of his emotional outbursts. We have also secondary age students with learning problems who resort to delinquent behavior. Usually the secondary age student comes to us from the junior high school.

Sometimes it is necessary to teach industrial arts information to students who cannot participate in the complete gamut of shop activities. Agreed, it is desirable that all students experience all the goals for an industrial arts program; however, there are times when physical impairment prohibits achievement of the goal. Currently our program includes a student with advanced stages of muscular dystrophy, one with neural damage caused by a cerebral hemorrhage during infancy, and several with epilepsy. The first case is very difficult because the student has only partial use of his right hand. Thus he requires assistance with toilet functions and movements in his wheelchair. He is capable, however, of spreading glue, sanding wood and so on. Also he can participate in management functions and verbal directions. The case involving the cerebral hemorrhage is a student who has a physically weakened right side. To overcome his weakened state, we have him doing gripping exercises and finger coordination tasks.

Periodically it is possible to use one of our student related needs to achieve an industrial arts goal. Last year we designed and built a rig which permits a child without legs to get himself a drink and to tend a cage of rats. The child was born without legs. he is deaf, and he had intestinal irregularities which necessitated that a colostomy be performed. The unit we designed and built permits the child to roll his wheel chair near

a platform, from there he grasps some dowel rods and pulls himself to an erect position. Then by propelling himself with his hands he gets to the water fountain and a cabinet. Solving real problems facing classmates has been a boom to the egoes of special education students.

Let us now look at some usual industrial arts type activities and compare special education achievement with achievement found in a normal classroom. first, however, let it be understood that special education classrooms are populated with students whose abilities and capacities vary along a greater range than do normal classroom populations. Hence, it is necessary that you allow the speaker to generalize when describing capabilities of handicapped students.

SPECIAL EDUCATION STUDENT'S CAPABILITIES

Industrial arts activities require a fairly uniform series of events to take place. For example, it is necessary for a student to select a task, a project, or a goal and to see that item through to completion. Hence, we may go through events such as selecting a project, planning, layout work, tool selection, tool usage, following instructions, working independently and working cooperatively. In regular classrooms, some teachers maintain project files from which students are permitted to make a choice. This teacher has no file of projects. He does, however, have many sources of ideas; i.e., Sears Roebuck's Catalog is a major source of classroom information. Not only can the catalog provide dimensions and related information, it can also be used for concurrent learning situations. Finding the item in the index may require a student to read. Other project ideas originate in publications such as House Beautiful, Better Homes and Gardens, toy catalogs, and Popular Science or Mechanics Illustrated. Regardless of the project's source, I attempt to have a student plan his activities in such a way that he or she understands what is happening along the construction route. Sometimes we meet with good success in developing the bill of materials. For the great majority of students, however, it has been found that the intricacies of a three view drawing are simply too abstract. Therefore, pictorial sketches and the bill of materials are used with greater understanding.

Due to the cost of materials, and the fact that we do not place any direct charges for materials against students, we use large quantities of particle board, low cost paints, and scrounged materials in our woods area. By using particle board we reduce the difficulties of cutting with and across grain patterns. Moreover, a 4 by 8 sheet of particle board is better for layout activities. I think the large sheet provides a better opportunity to teach about the conservation of materials. A few students, however, have absolutely no idea that a manufacturer's edge is a reliable starting point, and therefore they would cut a six inch square from the center of a sheet. It is in the layout activities that we return to the procedures necessary to read rules, to add and subtract both whole numbers and fractions, as well as the new learning in the use of layout tools.

Special education students seem to be no better nor worse than regular classroom students in their ability, or willingness, to select and to use tools appropriately and properly. Early instructional units devote time and effort to explain why a ballpeen hammer is used in the metal trades whereas a claw hammer is used in the wood trades. Of course there is the occasional lapse and the student uses a ballpeen hammer to drive nails. Overall, special education students are really quite good about tool selection.

Because many jobs which are available to special education people are routine and sequential, I attempt to teach students sequential events. For example, think about dish washing, a common job for people with marginal skills. Interruption of the waste food event does cause problems in the dishwashing machine. Thus I try to teach students to follow directions, to work in sequence, and to stay with the task. Industry requires each of these items, and it is a responsibility of industrial arts classes to teach special education students to meet the challenge.

During my tenure as a public school industrial arts teacher, one of the most disturbing situations has been that of students vandalizing or pilfering another student's work. So far it has been found that special education students can be controlled in this area. I have found that a potential troublesome student does several inspection trips before he attempts to create a problem. If spotted in time, the student can usually be assigned to assist someone, and once he is involved, the probability of delinquent behavior is reduced.

It seems that special education students are more difficult to get to work cooperatively than are regular students. Thus, I try to create situations in which one student must help

another. However, when the students are working together, one hears a large amount of verbal abuse taking place. Derogatory remarks about each other's intelligence is common. I use the communications difficulties between students as learning procedures with students. Why did Joe get angry, or not follow your dire ons? By putting the teacher's shoes onto the student, there is a learning advantage.

Because we do spend large amounts of time discussing with students the problems of communication, interpersonal conflicts, and reaction to one's environment, I find that the industrial arts teacher must be at least as much of a counselor as he is a teacher. Without the student's attention, it is difficult to teach him anything.

SUPPORT FOR THE PROGRAM

Fiscal support for the Madrona Heights School prevocational shop program is derived from both local and state funding. We have a regular district per capita amount and then we draw a state stipend as well. Within the building, the shop program competes with others, however.

Administrative support within the building and the district has been outstanding. Positive responses to program requirements do occur.

EVALUATION

The teacher assumes all responsibility for the evaluation of students within the prevocational shop classes. There is an estimate made of a student's potential, and several estimates of achievement are gathered in formulating a grade or reward. Each grade is a comparison of the student's achievement with the goals that the teacher has established for the student. For example, everyone is required to identify basic tools and to demonstrate their use. But for trainables, I do not require that they differentiate between a ball peen hammer and claw hammer. Better students are required to read micrometers, extract information from tap drill charts, and to calculate area and cost.

School district policy requires that the building principal evaluate the teacher yearly. In addition to the teacher evaluation, a program evaluation is done by a staff review. Also the state monitors special education through review teams.

RESEARCH PROJECTS UNDERWAY

At this time we are operating two separate research studies which fall under the direct supervision of the prevocational teacher. Our first project is titled, "Maturity — a Prerequisite for Training and/or Employment." Perhaps you have experience with special education students and realize that their ability to budget and to use time productively is one major difficulty. We use videotape to record a student throughout the day. Our technique is to show the student a filmed interview with two employers. The employers answer three questions: "What do you look for when a prospective new employee comes to you asking for a job? What do you require of the new employee the first day on the job? And, what do you expect of an employee after six months?" I then sit down with the student and show him/her the employer interview film. I ask the student to compare his/her current skills with the employers requirements. The student then gets to see himself/herself in action. We discuss the student's use of time and establish goals for behavior modification. Later we get a second taping of the student and look for changes.

Our second research grant deals with the preparation of vocationally related reading materials. Currently we have prepared flash cards for carpentry tools, mechanics tools, auto parts and child care. Also we are rewriting information in child care, cosmetology, mechanics and building trades. Our purposes in the reading project are twofold. First, we must teach the students vocationally related materials, and second we must teach children to read.

I now have a series of 35 mm slides which have been taken in our facilities. You will see that this building is deserving of the award it won in the Burlington House Architectural competition.

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An ESEA Title I Activity, Basic Occupational and Skill Training (BOAST)

Siegfried G. Mueller and Joseph Schroeder

This paper presents a description and overview of evaluation results on a dropout prevention activity. The BOAST activity has been providing vocational experiences in fully equipped shops for individuals and small groups in the Chicago public schools since 1967. The purpose of the activity is to motivate students who are considered potential dropouts to remain in school.

The main thrust of the activity has been to assist serious underachieving overage students between the ages of 13 and 16 who have not achieved in the traditional classroom setting.

During school year 1975-76 about 1,350 eligible students who have been identified as potential dropouts and in need of special educational, social and vocational guidance are enrolled in 11 centers where the BOAST activity is operational.

Over the years the main thrust of the BOAST activity has been the vocational aspect of the activity. However, the value of the activity is that content subject areas are integrated with shop activities and tutoring in reading as well as group and individual career and personal guidance is provided. The activity definitely familiarizes a student to the disciplines of a practical working shop in addition to the traditional school subjects. Activities are provided for both boys and girls. Underachievers are given the opportunity to succeed in a "sheltered" environment that allows them to learn and produce saleable products. Products are sold to local community agencies, stores and offices. Profits are used to buy additional materials and equipment, thus making BOAST somewhat self sustaining on the local level. Participants have made everything from awnings to license plate holders in the past, and the home economics sections of BOAST have enabled participants to acquire skills in dress making, cooking, etc. BOAST students are given the opportunity to create and see the practical value of their efforts.

Past evaluations of the BOAST activity have indicated that the majority of participants have improved from a prevocational rating of poor or fair, to average or excellent over a period of about 9 months in the activity. During the 1973-74 school year the vocational objective of BOAST was the following:

Given training and the opportunity to complete a series of sequential vocational projects, at least 30 percent of the pupils will demonstrate excellent achievement on vocational assignments. In addition, 60 percent of the participants will achieve at least an average vocational rating on their projects as indicated by shop teacher evaluation reports.

BOAST participants were rated in January, June and August to collect data. The areas in which the students were rated were:

Ability to plan work
Attitude and ability to work cooperatively
Quality of manipulative work
Knowledge of related information

Although the first part of the objective was not achieved, the students surpassed expected outcomes in every area specified in the second part of the objective.

A pupil attitude inventory instrument was used to determine to what degree the BOAST activity met the following objective.

Given at least 9 months' participation in the activity, at least 60 percent of the pupils will have scores for each attitude factor (self esteem, concern for others and attitude toward school) indicating a positive change or maintenance of a positive characteristic necessary for growth in the classroom environment.

The highest degree of achievement was noted in the factor "attitude toward school." Over the years BOAST has been partially successful in meeting all the performance objectives. However, due to problems that arise when working with young adolescents who have a history of under achievement, excessive absenteeism and living in an impoverished environment, achieving success with 50 percent of the participants is acceptable.

In addition, students referred to the Educational and Vocational Guidance Centers are not usually from the immediate area and must take public transportation at their own expense. That may be why the analysis of attendance data on participants over the past five years has revealed that between 40 and 50 percent of the participants have attended school 90 or more percent of the time. Data obtained from the 1972-73 and 1973-74 Student Evaluation Form show that BOAST did not achieve the objective which stated that a minimum of 60 percent of the students will have at least 90 percent attendance. This is in spite of the guidance component of the activity which includes, in addition to a special service coordinator who provides counseling, a home visitor who follows up on communication and liaison between the school and home.

Although BOAST was considered a weak activity in reading achievement compared to basic Title I reading activities, the past few years have shown more emphasis placed on reading in the vocational guidance centers conducting the BOAST activity.

During the 1972-73 and 1973-74 school years, not all BOAST students received a pretest and posttest in reading due either to illness, mobility or an error in the participants identification number which prevented the matching of some of the tests. Tests administered were the ITBS Level 12 and 13 for pretests and IBS Level 14 for posttests.

In January 1972 statistics supplied by the Department of Data Processing regarding the status of post BOAST participants were tabulated and analyzed by the ESEA Division of Research and Evaluation, Chicago public schools. This study included the distribution and status of 1,591 identified students who participated in the BOAST activity between September 1968 and June 1970. BOAST accomplished a high degree of success in keeping potential dropouts in school.

ANALYSIS OF DATA

Of the total number of pupils who participated in the BOAST activity in 1968-69, the cumulative dropout rate from September 1968 through June 1971 was 25.6 percent. This figure was lower than the dropout rate of other schools in the same locality. The yearly dropout rate for the 1968-69 participants was 8.5 percent. The cumulative dropout rate for the 1969-70 participants as of June 1971 was 25.4 percent. The yearly dropout rate for the 1969-70 participants was 12.7 percent.

As reported in Facts and Figures, Chicago Public Schools, 1970-71, the yearly dropout rate for 1968-69 was 10 percent. The dropout rate for 1969-70 was 10.2 percent. In the High School Dropout Report, prepared by the Bureau of Administrative Research, the

dropout rate of all Chicago public high schools was listed as 9.1 percent for school year 1970-71. (It is important to note the dropout rate listed in citywide high school students is not cumulative but yearly.)

Past evaluations on BOAST have indicated that generally, participants achieved considerable success in their vocational activities but little success in their reading or academic activities when compared with other activities. These evaluators understand, however, that more emphasis is being placed on remedial reading instruction in the past year than in previous years. In the near future, data will be available to allow staff to determine how effective BOAST has been in the past 5 or 6 years in preventing participants from dropping out of school. If you are interested in this study, or one being currently concluded by CTB-McGraw Hill, please write to Joseph Schroeder, 2021 North Burling, Chicago, Ill. 60601.

Dr. Mueller and Mr. Schroeder are research staff members with the Chicago Public Schools.

Teacher Education

Scouting Activities in Industrial Arts Programs

E. Allen Bame

The AIAA Scouting Committee has been involved for several years in trying to put together a booklet that explains a procedure for organizing students in industrial arts teacher education programs to teach Boy Scout merit badges. This program has been tried successfully at San Jose State University and at Virginia Polytechnic Institute and State University. Both programs have had great success with students getting teaching experience and Scouts receiving good instruction and assistance with merit badges.

The merit badge counseling program in teacher education programs is based on the belief that contact and involvement with children in a teaching-learning environment is important to the complete education of the prospective teacher. When teacher education students are able to get tangible feedback from such experiences, they are able to draw more valid conclusions concerning their competence in working with children. When the learning experience occurs in the presence of constructive evaluation from a teacher education faculty member, professional growth can result far beyond that normally experienced in the traditional teaching methods class.

Several factors contribute to an ideal learning environment for the teacher education student. The students being taught (the Scouts) will be the same age as the students the teacher will later work with in the junior high school laboratory. The Scouts will be highly motivated. This will help assure a positive experience for the teacher education student. The number of Scouts will, in a particular merit badge session, be smaller than the typical industrial arts class or can purposely be kept small. This will also help assure a successful experience. The requirements for the badges are spelled out in the merit badge pamphlets as well as the instructional content of each badge. This, then, provides the teacher with a "textbook" written for the age level of the Scouts. The merit badge pamphlet also provides the teacher with a rough course outline that can be used in the development of specific teaching-learning experiences to be organized in the laboratory.

HOW THE PROGRAM WORKS

In the program currently being tested at VPI and SU, a faculty member acts as the coordinator of the program and also serves as the "official" merit badge counselor.

This person is a recognized merit badge counselor, registered with the local Boy Scout council office to counsel the badges being taught by his students. This faculty member is assisted by a student, often a graduate student, who schedules the use of the facilities, arranges for necessary publicity, organizes the students who will be working with the Scouts and assists with the teaching when necessary.

Publicity for the merit badge classes is arranged through local newspapers, radio and the local Boy Scout council newsletter to leaders. The news release includes the usual listing of time, place and merit badges to be counseled.

A schedule of four or five Saturday morning classes has been adequate for the Scouts to complete work on their badges. In some cases a Scout is not able to complete all the requirements in the specified time and must then work individually with the student who has been instructing him, the faculty counselor or another regularly listed counselor in the area.

Students who are involved in the teaching are volunteers usually from the junior and senior classes. The most success in obtaining volunteers has come when the program was offered the term immediately preceding student teaching. The seniors who were soon to be student teaching were very anxious to get the program started.

The merit badge counseling program has also had great success when organized in conjunction with the class in industrial arts teaching methods. The counseling activity was used as the application and evaluation phase of this methods class. During the early phases of the class, the teacher education students were given instruction in teaching methods and were required to prepare lesson plans and teaching materials for the merit badge classes they were to teach. They used two merit badge pamphlets as their outline and source of content. These lesson plans, once approved by the methods class instructor, were then used in the merit badge classes. The class instructor was able to observe the work of his students as they taught the Scouts. This provided a very real teaching situation for the teacher education students. It also provided the university instructor with a situation in which meaningful evaluation could be made of the progress of the students in his class. Critique sessions were held after each Saturday's merit badge classes and the teacher education students were able to get nearly immediate feedback and evaluation from their instructor. Though not being used where the teaching activities of the students are videotaped and then played back to the students for their own critique. This technique has proved very successful in other applications and should be quite successful in this program.

MERIT BADGE COUNSELING IN PUBLIC SCHOOLS

The above described program is limited to the college and university teacher preparation programs. The counseling of merit badges for Boy Scouts and Girl Scouts is not limited to this level, however. The industrial arts teacher in the junior high school or high school can provide valuable service to the community if he or she will work with the local Scout groups as a merit badge counselor. Many of the things done in the industrial arts program are similar to the requirements for the Scout badges for advancement. Merit badges in leatherwork, metalwork, photography, woodwork, pottery, printing, electricity, electronics, drafting and woodcarving are examples of several from the list of Boy Scout merit badges.

When the industrial arts teacher serves as a merit badge counselor, there is increased opportunity for publicity of the industrial arts program. It is quite likely that there will be several Scouts coming into the industrial arts lab who have not been in it before. Obviously, they are potential new students. Publicity and public relations gained from the merit badge counseling activity of the industrial arts teacher will also have "rub off" benefit for the industrial arts program.

If you are interested in working as a merit badge counselor, I suggest that you contact your local Girl Scout and Boy Scout offices for information and assistance in getting started. Visit a weekly meeting of a Scout troop in your neighborhood. Very rarely will a volunteer who is offering his services as a merit badge counselor be turned away. We industrial arts teachers have a valuable service we can perform. It is a service that is in great demand.

The AIAA Scouting Committee also welcomes the assistance of industrial arts teachers who would like to work on the committee. We are presently involved in the final writing of a booklet describing the merit badge counseling program in teacher education

institutions. In the near future, we plan to expand our activities to include the counseling of badges for the Girl Scouts. We are also working with the National Council, Boy Scouts of America in reviewing revisions of merit badges that fall into the subject matter areas of industrial arts. In some cases our members will become involved with trial application of new requirements before they are put into final print in revised merit badge pamphlets. The AIAA Scouting Committee needs and welcomes your help.

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The College and the Department

Walter R. Bortz

The development and success of a college and departmental honors program must permit each sub-division to function fully. The solution of basic problems such as this helps in a very large way toward carrying on honors programs. Students and faculty must be stimulated to make honors programs current, meaningful and worth-while. They should blend the advantages of the breadth associated with liberal arts and the specificity of technology. Flexibility and a challenging fulfillment of the student's program goals must characterize the program.

Constructing a student's dream program is not always as easy as one might like it to be. Problems are bound to occur. Sometimes the faculty responds with, "We never did it that way." Maybe the fact that the student's goal has not been done before tends to discourage him from pursuing an honors program. Real problems do exist, but only to the extent that faculty let them exist.

Honors students need more attention than others at times to help them to be successful. More is demanded from both the student and the faculty because of the specific needs of each honors program.

The curriculum goal sought by liberal arts advocates has been the Renaissance ideal of a "universal man." This ideal has been portrayed most clearly by Leonardo da Vinci (1452-1519). He won fame as a painter, an architect, an engineer, a musician, and for his work with anatomy, mathematics and astronomy. In a very real sense, opposition to this position gains support due to the impossibility of most people achieving such goals. The question has been, "Should not a person need to have such knowledge at one's disposal to function intelligently in society today, even though a person may not experience the laurels of recognition in so many areas as Leonardo?"

The opposing position assumes that a person can be educated to becoming a specialist. While this position is not as popular, it is workable. The specialists (technologists) can be grouped to work as teams to solve difficult new problems.

Perhaps the sentiment connected with a "Renaissance man" keeps this notion alive. Man wants to conquer the impossible or the difficult to feed his ego. The tension between the liberal arts and the technological approach has existed for many years, and the technological seems to be gaining in recent years.

Honors students, in most cases, do not follow the polarized positions. One of the unique features of an honors program is that the student sets his or her own goals and then works to achieve them. The difference between a department's program and a personal program generally brings about an enthusiastic response from the student. I must succeed because it is "my" program!

The format for an honors program needs a humanizing touch, a student-centered emphasis. We in industrial arts have asked a great deal of our students. We have asked them to become proficient with many processes, materials and systems. Tension exists between the complexities of the mind and motor responses and Kotarbinski's definition of praxiology as "the science of efficient action" (Kotarbinski, 1962, p. 211).

The necessity of efficiently selecting materials, processes and systems to accomplish a task successfully leaves everything open-ended; finalized in part, but not com-

pletely defined. This tension accompanies a student's honors program. The value of this dimension of an honors program is that it acquaints the student with the responsibility of acting and living with his or her "best" thinking while in a closely-watched college environment and interacting with other able minds.

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Installing CBTE in Professional and Lab Courses

David L. DePue

Much attention has been focused on competency/performance-based teacher education. Many educators feel that this movement is the means for a significant improvement in education.

What is PBTE – CBTE?

While many writers use these terms synonymously, others see a difference. Kelly (1, p. 11) distinguishes between CBTE and PBTE by the extent of the promises which can be made in the preparation of teachers.

> Performance-Based: Program is organized with primary emphasis on the teaching behavior to be demonstrated...
>
> Competency-Based: A CBTE program is, by definition, more concerned with the consequences obtained...the desired results or consequences to occur when the preservice teacher is teaching pupils.[1]

It is assumed that teacher educators are initially concerned with the performance of the teacher candidates; therefore this article will address PBTE. Competency, as used in this paper, will refer to the teacher candidates' ability to perform at a specified level.

Once a decision has been made to move toward PBTE, there are three main elements to consider: (1) What competencies are needed for a prospective teacher to perform adequately? (2) How are these competencies delivered? (3) How is the performance evaluated? Those wishing to study the issue more closely or to effect more than mere program change might start with the excellent articles in the summer 1975 issue of the Journal of Industrial Teacher Education or the January 1974 issue of the Phi Delta Kappan. The soon to be published ACIATE 1977 Yearbook will also be devoted entirely to CBTE.

THE THREE PROGRAM COMPONENTS

The college education of an aspiring I.A. teacher can be divided into these areas: (1) The liberal education courses; i.e., math, science, humanities; (2) the student's major area; i.e., power, graphics, materials; (3) professional methods courses; i.e., teaching methods, curriculum and evaluation.

There is much controversy in the liberal education area due to resistance of professors outside of the field of education to become involved in PBTE. The opposition is surprising, for this same group has traditionally criticized education for lacking a true science base. Now it appears that our profession is on the verge of establishing a codified body of knowledge along with a systematic delivery system, and we are held back by our former advocators. At best we can only exert influence in this direction while

effecting change in the areas which we control. In time, any results should lend credibility to these innovations.

The teaching methods area has had the most attention and subsequent development. Here we identify the skills needed — i.e., lesson delivery, use of aids, questioning skills — then make sure the teacher candidate obtains these skills before moving on. The program development practices will be addressed within the next subheadings.

Teaching subject area development has had little attention in PBTE. A primary reason for this lack of attention is that the subject area courses of most education majors are not within the college of education. Practical arts subject matter, however, is normally within our control. Beginning efforts in this area are a major thrust of this paper.

DETERMINING TEACHER COMPETENCIES

The first element needed in a PBTE program is a list of competencies which are necessary for a beginning teacher to perform adequately. Houston[2] suggests several approaches to specifying teaching competencies. Much work has already been done for us in this area. Cotrell[3] has identified 384 professional occupational teacher education competencies in a national study. The faculty of the Department of Vocational and Applied Arts Education at Wayne State University has revised Cotrell's list and identified 75 pre-service teaching competencies. Popovich[4] validated this shortened listing in a 1973 dissertation. Other useful competency lists for industrial education have been developed by Giachino[5], Mansfield[6], Silvius[7] and Walsh[8].

Before using a ready-made competency list, however, it might be wise to heed the advice of several contributors to Houston and Howsam's popular CBTE text.[9] Include those involved with your program in any decision-making activities. Our colleagues Brooks and Brueckman[10] suggest submitting your competency list for rating to a broad-based jury. Members of a jury might include one or more representatives of public school I.A. teachers, public school administrators and guidance personnel, I.A. college students, representatives of I.A. professional associations and inter-disciplinary college departments.

TECHNICAL-LAB COMPETENCIES

Subject matter competencies in I.A. are to be developed by the student in our labs. As a result of the student's earning a passing grade in such a lab course, our respective state department normally certifies this prospective teacher to teach this lab area in our public schools. But just what can this teacher candidate do? What are his abilities? There can be little quantitative evaluation of teacher expertise in any lab area without a professional identification and ordering of the desired competencies.

Competency lists for I.A. lab areas are not readily available. dissertations in our field have, to date, focused on teaching competencies, knowledge proficiency, and study units. Perhaps the best work available is a preliminary list developed for a project directed by Stanley E. Brooks[10] at Buffalo State. This project focused on junior and senior high school subject area competencies needed by a beginning teacher.

If you plan to refine an existing group of competencies or to develop your own list, a structure or theme will be needed to organize the items. An excellent development approach is offered by A. D. Hauenstein[11] and was used by this writer in developing a competency list for power. As previously mentioned, it will be necessary to select a jury to perform assessment duties prior to building an instructional system around any competency list.

LEARNING AND EVALUATION ACTIVITIES

Learning sequences are needed to allow students to obtain the specified competencies. This element may be the simplest to organize for I.A. instructors in activity-centered courses. The term used to describe a common group of instructional activities in a PBTE program is a "module." This is similar to the familiar instruction "unit" and can serve the same purpose.

The significant element in a module within a PBTE program is the evaluation. A student is assessed in reference to a specific criterion or standard of performance. This assessment is in contrast to using norm-referenced measurements. This means that

a student is asked to perform to a previously determined standard, regardless of his or his classmates' accomplishments.

Because of the assessment methods, most PBTE modules are individualized and self-paced. However, learning activities can also include projects, field trips, experiments, discussions, guest speakers, films, videotapes and even lectures. Any activity which helps the student to perform at the specified level can be considered. Perhaps the more significant difference in our program would be the increased use of performance tests and lesser use of knowledge and recall to assess our prospective teachers.

One of the more satisfying effects of such an instructional system is that a student who already possesses the skills and knowledges can demonstrate this and move on to new material. Conversely, the student who lacks adequate background and understanding can use his time to measure up to the standards, rather than fail due to lack of time.

Can you find a starting place and move away from an emphasis on knowledge and toward a performance-based program? You owe it to your present students and their future classes.

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An Industrial Arts Experience in "Living and Learning"

Denis J. Foley, Jr.

As educators, we sometimes need to be reminded how much we have learned of the important lessons of life in informal settings. I'm sure many industrial arts teachers still "brown bag" lunch, at least occasionally, and know the value of the impromptu bull

sessions, which sometimes add sauce to the sandwiches. I still remember well a bit of advice given me by a friend and former colleague at New York University during such a lunch time discussion. In fact, I still have the scrap of wrapping paper on which he wrote his pearl of wisdom so that I would not forget it. Dr. Raymond Van Tassel, Professor Emeritus and former chairman of the Department of Vocational Education at New York University, said neither a philosopher nor a scientist be, because:

> A <u>philosopher</u> knows a little about everything, and learns less about more, until he knows <u>nothing about</u> everything;
>
> A <u>scientist</u> knows a lot about a little, and learns more about less, until he knows everything <u>about</u> nothing.

In a culture as complex as ours, some of the breadth of the philosopher and the depth of the scientist are valuable in each citizen. There are some inherent obstacles in traditionally structured schools which make it difficult for teachers to provide students with opportunities to acquire both broad approaches to problems, and the knowledge and skills necessary for in-depth analysis.

"Living and Learning" was developed at Millersville State College in Pennsylvania to provide teachers of all disciplines with opportunities to broaden their own perspectives and develop additional knowledge and skills needed to return to their schools prepared to provide interdisciplinary action-learning environments for their students. First, I will expand upon these two elements of the program — interdisciplinary education, and action-learning — and then share with you a slide tape program developed during June 1975 as part of the "Living and Learning" program.

In the report of the Panel on Youth of the President's Science Advisory Committee, Summer 1973, James S. Coleman identified objectives for youth and indicated that the schools, as usually structured, may not provide adequate environments for accomplishing them. I think you will see that the "Living and Learning" approach may deal more adequately with some of them. The objectives are:

(a) Self-centered objectives
1. Cognitive and non-cognitive skills necessary for economic independence and for occupational opportunities.
2. Capability of effective management of one's own affairs.
3. Capabilities as a consumer, not only of goods, but, more significantly, of the cultural riches of civilization.
4. Capabilities for engaging in intense, concentrated involvement in an activity.

(b) Objectives involving responsibilities affecting other
1. Experience with persons different from himself, not only in social class and sub-culture, but also in age.
2. The experience of having others dependent on one's actions.
3. Interdependent activities directed toward collective goals.[1]

The <u>Dictionary of Education</u> does not deal with interdisciplinary education directly, but defines an interdisciplinary course as:

> a course, usually experimental, that attempts to utilize the findings and principles of more than one academic discipline, usually topic-centered, focusing on some new area of concern for analysis, regardless of how it fits the traditional points of view of established disciplines; instituted both in universities and high schools for the solution of problems involving subject matter from various fields.[2]

Numerous examples exist in any library of the interdisciplinary approach being used to solve real life problems outside of schools. Some examples are:

P. M. Ku (editor), <u>Interdisciplinary Approach to Friction and Wear</u>; a NASA-sponsored symposium.[3]

Gary B. Nash, <u>Class and Society in Early America</u>; part of a series called Interdisciplinary Approaches to History.[4]

Darrel B. Carter (editor), Interdisciplinary Approaches to Learning Disorders; a symposium by 13 contributors.[5]

Lynn Margulis (editor), Chemistry and Radio Astronomy; proceedings of 4th Conference on Origins of Life conducted by the Interdisciplinary Communications Program of the Smithsonian Institution.[6]

Stewart Wolf, The Artery and the Process of Arteriosclerosis; proceedings of Interdisciplinary Conference or Fundamental Data on Reactions of Vascular Tissue in Man.[7]

Paul G. Kuntz (editor), The Concept of Order; collection of the papers presented in a series of lectures entitled Interdisciplinary Seminar on Order.[8]

Creativity and Its Cultivation; addresses presented at the Interdisciplinary Symposia on Creativity, Michigan State University.[9]

Muzafer and Carolyn Sherif (editors), Interdisciplinary Relationships in the Social Sciences.[10]

In some cases the above sources represent a serial approach to a single problem by contributors from various disciplines; in others a serious effort is made to correlate or integrate the insights of the various participants. Regardless of the approach used, there is recognition of the fact that life problems are rarely limited to a single discipline.

Have schools, in an attempt to assist learners in understanding life problems, created artificial divisions of knowledge which sometimes become barriers to the solution of these very problems? Are the attempts of many in education to make school more relevant to life further confirmation of the student's perception of the separateness of school and life? How can schools assist students in learning to use all their knowledge and skills in solving real life problems? Further, how can we provide students with opportunities to learn from life problems, which they will need to do long after formal schooling is completed?

Several writers have described their attempts to use interdisciplinary approaches to make school more responsive to real needs of students. Quina and Greenlaw have used science-fiction as a mode for interdisciplinary education. They start with the following definition:

> *Interdisciplinary education is an attempt to investigate multiple fields of knowledge to reveal the impact each has on the others. Traditional education has concentrated on discrete knowledge, leaving the student to amass the parts into some type of whole without direction or comment. The interdisciplinary process examines segments of knowledge, but more important, it strives to assist the student in developing some cohesive outlook on the world.*[11]

These authors point out both the value of starting teaching with immediate student interests and the necessity of having students move beyond their immediate concerns to the broader kinds of growth educators value. Ten general goals which have emerged from undergraduate experiences with interdisciplinary study of science fiction are worthy of careful consideration by others engaged in interdisciplinary education, regardless of the mode of study used. They are:

1. To develop in the student a sustaining interest in one or more disciplines rather than a mechanical acceptance.
2. To help the student discover the existence of fields and subjects other than those few he may initially be familiar with and enjoy.
3. To stretch the interest and enjoyment students feel for familiar fields (disciplines) to include other, newly discovered disciplines.
4. To help students develop open, inquiring minds which question, search for reasons, ask how and why.
5. To help the student to recognize, accept, and possibly develop new perspectives of thought, understanding, logic and belief.
6. To help the student develop new communication skills, verbal and nonverbal.
7. To help the student develop independent research techniques, to become his own historian, scientist, or linguist.
8. To help the student work with other students in various climates: intellectual, social, emotive, valuing.
9. To help students reformulate values, beliefs and modes of evidence as a continuing life process.

10. To help students develop guidelines and techniques such that they can continue to educate themselves throughout life, no matter what interests or patterns may emerge or what they want to learn.[12]

Dr. Jon M. Veigel, who has taught interdisciplinary courses in the areas of energy and the environment since 1968, has taken a scholarly look at both the needs for interdisciplinary approaches to real problems of society and the equally real hazards and risks of professors and college students who attempt to cross traditional disciplinary boundaries. He sees the next few years as crucial ones in determining the stability of environmental programs in higher education.[13]

Another writer has noted the need to integrate not only the various cognitive disciplines, but to recognize that both cognitive and affective learning are equally essential for the student's success in the future. F. Jane Cotton, a top Red Cross official, has observed:

> Perhaps our concern should be not whether more emphasis is placed on affective rather than cognitive education but, rather, on how we can put the two together as equally essential. Human survival in the future will rest heavily on a person's ability to learn new skills throughout one's working life, to frequently leave a familiar community and make new friends in another, to learn to understand and work with people of different ethnic backgrounds, to readjust one's thinking and to admit new information and discard that which has been shown to be faulty. All of these needs will require the development of an emotionally strong individual who, as Rogers states, has learned how to learn; has learned how to adapt and change; has realized that no knowledge is secure, that only the process of seeking knowledge gives a basis for security.[14]

The article describes several programs which involve students in important learning experiences in the community. Note that we are now considering more than crossing traditional subject lines in a school setting. Action-learning goes beyond the school into the community to provide additional learning environments for students.

Gary H. Deutschlander has defined action-learning as, "planned activities organized through a school that provide a chance to learn by doing."[15] Industrial arts teachers would be quick to point out that they have been doing a pretty good job of providing learn-by-doing experiences for students all along. Action-learning includes work (for pay)-study programs and community service experiences, but is not limited to these. The "Living-Learning" program for implementing interdisciplinary education, developed at Millersville State College (PA) in June 1975, is certainly an example of action-learning. Deutschlander has identified eight important issues which schools must respond to as they develop action-learning programs. They are:

1. How can experiential activities, especially of the service variety, be effectively structured for teaching and learning?
2. What are the specific behavioral objectives the school expects a given action-learning experience or set of experiences to serve so far as students are concerned?
3. What evaluation instruments and procedures need to be developed in order to give a reasonably complete and meaningful picture of a student's performance and progress as a result of his involvement in an action-learning program?
4. How, where, and what kind of action-learning opportunities (existing or to be created) can be used effectively as integral elements of ongoing academic course offerings?
5. What changes in the over-all content and structure of the school's curriculum can be anticipated as action-learning opportunities proliferate?
6. What policies and procedures are likely to be most helpful in selecting and training school staff members for effective participation in an action-learning program? On-site supervisors, also?
7. And what about experiential possibilities for younger students?
8. Are there any particular kinds of off-campus experiences that ought to be required of all students at some given grade or course level? Should some form of action-learning experience be a graduation requirement or should participation be entirely a matter of student election?[16]

Mr. Deutschlander's paper was one of five presented in April 1974 at the Wingspread Conference, Racine, Wisconsin. At the invitation of the National Association of Secondary

School Principals, 50 educators spent 2 days discussing the role of action-learning in the schools. The other papers discussed were:

"The Role of the School Adviser in Action Learning" by James O. Reiels.[17]

"Relations with the Community in Action-Learning Programs" by Gerald E. Kusler.[18]

"Some Administrative Considerations" by William Dutch[19]

"Evaluation and Action-Learning Programs" by Alexander M. Moore.[20]

Each of the above papers was reported in the NASSP Bulletin, Volume 58, November 1974. A separate article reported "Concluding Observations and Recommendations."

One part of that report, which seems to have special relevance to our "Living and Learning" program, summarizes the central benefits of action-learning programs as follows:

> (a) They provide learning experiences that youth otherwise would miss: Service to others, responsibility for others, interaction with various age groups, gaining competencies for work and becoming involved with the working world of adults.
> (b) They provide some assurance to youth that adulthood is coming closer. In response, youth attitudes and actions mature.
> (c) They broaden an understanding of the real world. As Socrates noted, education should be moved "from the shadow of reality to reality itself." Youth today tend to be sheltered from serious work, causing deficiencies in learning.
> (d) They help provide elements important to the conditions for learning; i.e., motivation, experience, transfer of training, association and verification.[21]

In case all of these considerations may seem overwhelming, take heart in the advice of William D. Romey, who said:

> In problem-centered approaches, we hunt for something we think is worth doing or knowing and then we try everything we can to solve the problem. No problem is too difficult. We don't worry about sloppiness to start with. We regard the growth of knowledge as a series of successive approximations, and we've got to start somewhere.[22]

Nor is the problem of dealing with an explosive growth of knowledge a new one. I would like to introduce the "Living and Learning" slide series with a poetic vision of the problem written in 1917 by Edna St. Vincent Millay.

> Upon this age, that never speaks its mind,
> This furtive age, this age endowed with power
> To wake the moon with footsteps, fit an oar
> Into the rowlocks of the wind, and find
> What swims before his prow, what swirls behind
> Upon this gifted age, in its dark hour,
> Rains from the sky a meteoric shower
> Of facts . . . they lie unquestioned, uncombined.
> Wisdom enough to leech us of our ill
> Is daily spun; but there exists no loom
> To weave it into fabric; . . .[23]

We think, at Millersville, that we have started to construct a loom with our "Living and Learning" course. You may develop some ideas that will help you build another loom — a better way to help your students deal more successfully with their own problems of living and learning.

The narrator for the slide series is Dr. George H. Ditlow, Chairman of the Department of Industrial Arts Education, Millersville State College, who taught the course in 1975 along with Dr. Mary Elizabeth Dixon of the Physical Education Department.

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Minicourses in Industrial Education

Gordon Gavin

For some time the business community has successfully used the "mini" idea. One hears and reads of mini-tours, mini-vacations, mini-parks, mini-zoos, mini-banks, mini-bikes, mini-institutions and mini-conventions. "Mini" stands for small, short,

abbreviated, economical, convenient, beneficial, enjoyable, fun and accessible to those with less time or money. The difference between a large park and its "mini" counterpart lies not in the quality, but in the quantity. A mini-vacation can be as much fun as a full-sized vacation except that the pleasure lasts fewer days.

Nowhere is the "mini" idea and what it represents more evident than in the automobile industry. Full-size cars used to dominate the automobile market. However, in the past decade the smaller cars have moved into the forefront. This is witnessed by small foreign cars, mini-busses, mini-pickup trucks, etc. If the "mini" idea is applicable to business, it would appear worthy of a thorough examination and use by the academic community.

A mini-course program originated at Mankato State University in the winter quarter, 1971. It was established in an attempt to generate more credit hours to save faculty positions which were being threatened by declining enrollments. It should also be pointed out that the university views the mini-course program as a means of introducing new subject matter, in addition to getting a variety of individuals from the community and surrounding area involved with the university.

MINI-COURSE GUIDELINES

The following guidelines prevail with the mini-course program at Mankato State University, Mankato, Minn.

1. A qualified staff member, but not necessarily a college professor.
2. The course must meet a minimum of 10 classroom or equivalent hours.
3. There are no admission requirements for participants in the mini-course program.
4. Credits earned in a department may count toward a student's major and/or minor requirements.
5. All undergraduate mini-courses are offered for P/N (Pass-No Credit) credit only. Graduate level courses are offered on a grade basis or P/N.
6. Student cost is for tuition only at the current rates.
   1 quarter hour undergraduate credit $ 9.00
   1 quarter hour graduate credit $11.50
7. Students may take only 2 quarter hours of mini-course credit per quarter without paying additional fees, i.e., Student Health, Student Activity, etc.
8. Mini-courses may be held in homes, churches, business establishments, at the college or various other locations.

Control of the mini-course program is vested in a subcommittee of the University Curriculum Committee.

MINI-COURSES IN INDUSTRIAL EDUCATION — MANKATO STATE UNIVERSITY

The introduction of mini-courses into the curriculum at Mankato State University brought a new dimension to course offerings. In addition to normal load, the following is a listing of some mini-courses that have been offered by the Industrial Technical Studies Unit.

Welding for Metal Sculptures	Candle Making
Gunsmithing	De-Bugging Your Bug
Blue Print Reading	Plant Safety
Developing Trouble Shooting Skills	Development of Cross-Country Skis
Stained Glass Practices	The Router
Amateur Radio	Chicago Auto Show
Christmas Crafts	Winter Fish House Construction
Basic Auto Tune-Up	The Geodesic Dome

These courses have been attended by many persons who are not enrolled in a university degree program. They include housewives, persons from business and industry and senior citizens. For them, the mini-courses have served a variety of purposes, including up-grading skills applicable to their vocations, exploring something they always were interested in or learning new items that could be carried out as leisure time

activities or hobbies. It also allowed the Industrial Technical Studies Department to make facilities, laboratories, and equipment available to many people who did not have, or could not afford, expensive tools and machines. For example, it would cost approximately $250.00 to buy or lease gas welding equipment. However, under the mini-course program an individual could, for $9.00 plus payment of materials, sign up and get a minimum of 10 hours of gas welding instruction and practice. Having done this, the individual would be in a much better position to decide whether or not he was ready to make the $250.00 investment, as well as have a better idea of what type of equipment to purchase.

Another example was the Christmas Crafts Mini-Course. During this course students were able to construct man Christmas gifts they could not make because of a lack of knowledge and equipment. The diversity of offerings is further shown by the Industrial Technical Studies Department offering in the area of machine metals. This was a specialized offering for an area electronics firm. They felt a practical background, combined with the theoretical preparation of their engineers, would help the engineers design products and processes that could be more realistically handled by the firm's production lines.

The mini-course program also allows staff to conduct offerings in areas of specialized interest. Such was the case of the mini-course in "Gunsmithing." Over 50 individuals enrolled to learn special techniques, data and ideas useful in both sporterizing and maintaining firearms. Instruction was provided by two practicing gunsmiths who volunteered a couple of evenings of their time, as well as that of an industrial technical studies staff member. In one case a biology professor offered a mini-course on "Plants and You." Much to his surprise, over 350 people registered for the course. Needless to say, some adjustments in the professor's schedule were necessary.

The typical mini-course will meet from three to five evenings or afternoons. Each meeting time will last from two to four hours. In most cases formal written tests are not administered, with evaluation being based on individual participation. In some cases fees are collected to cover the cost of instructional supplies or materials used during the course.

The mini-course program at Mankato State University has been formally evaluated on several occasions. All evaluations are of a positive nature. The program has provided the community with a variety of course offerings not otherwise possible, as well as getting the community more involved with the University.

MINI-COURSES IN SECONDARY EDUCATION

Many secondary education institutions also make use of mini-course. This provides the students with an opportunity to explore a variety of interest areas. One school that I know of, has one day each year set aside for mini-courses. Students are permitted to enroll in activities scheduled for the entire day or two shorter sessions, each for one-half day. Topics range from photography or needle point to ice fishing or curling. Some institutions offer the mini-courses on an interim basis. A week between quarters might be set aside for such offerings. Still in some cases offerings are provided during vacation periods such as Christmas and Easter.

SUMMARY

Mini-courses do have merit. They:

1. Provide students with an opportunity to explore interested areas.
2. Can draw the community and university closer.
3. Tend to break down the formal structure or image sometimes held by higher education institutions.
4. Can provide members of the community with an opportunity to express their interests and talents.
5. Provide for a shorter, more flexible method of study.

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Energy Power Instrumentation and Control—Using a Mastery Learning System

David V. Gedeon and Ronald Jacobs

The contemporary emphasis in education is on individualizing instruction, whether it be for an entire college, school, or simply a course. This notion has displaced group instruction, and in some instances the traditional time frame of an academic year.

Students enter a course with such diverse capabilities that it is next to impossible to group individuals according to abilities and to use the lecture method as an exclusive delivery system of critical information and synthesizing information. A limited review of the literature on individualized instruction, mastery learning and competency-based instruction has suggested that more content can be presented, slower students can have greater individual attention from the instructor, students work harder and accomplish more, and the over-all grade avarage of the class improves (Block, 1976). After seeing some effect from industrial training — Michigan Bell, Digital Equipment Corporation, ARO Corporation — and from the educational enterprise, one would wonder how individualized instruction and mastery learning could be applied to other curricular areas. The authors were especially interested in using mastery learning and individualizing instruction within a general core course.

CONTENT OVERVIEW

The Department of Industrial Education and Technology is organized for two purposes — teacher preparation and technologist preparation. The curriculum is organized around a core curriculum. It has been rationalized that the core content (skills and knowledge) provides the student with an overview of industrial technology. Concentrations and programs are built upon each of the core areas, construction, manufacturing, visual communications and EPIC. The EPIC is an abbreviated form for energy power instrumentation and control. Two courses constitute the core. The first is EPIC Mechanization, which is conceptualized, organized and emphasizes the EP — energy and power. The second course is EPIC Cybernetics, which is focused on the IC — instrumentation and control.

The cybernetic has been analyzed from a typical process control model. The model served as a terminal cognitive map which the student would possess to analyze, diagnose or design any control system. With the end in mind, two questions were always asked: What does the student need to know before he can do it? Secondly, what does the student need to know before he understands the function of each component and their relationship to one another?

THE METHODS

The class size for EPIC — Cybernetics has a ceiling of 22 and the number of stations per activity varies from 1 to 7. Resulting from the mix of content, student ability levels, varying number of stations and a class size of 22, the coordination and sequencing of content for students became a major problem. It is a problem common to any teaching and supervision of multiple activities. A teaching-learning approach that was initially used was to lecture about the content and give demonstrations in a given hierarchy so that some students could engage in selected laboratory activities which reinforced and/or extended what has been presented. Then, shift into another hierarchy and proceed to lecture and demonstrate to enable students to have minimum information to perform the laaoratory experiences in another hierarchy. With this approach, the lectures reached 50 percent or less of the students at any time. Student motivation to listen was hinged upon whether or not they were engaged in the laboratory activities.

Another problem was the need to repeat lecture material and demonstrations because students did not have close continuity of instruction followed by immediate practice or application. This constitutes a violation of a fundamental learning principle.

An alternative approach to the foregoing would be to teach all the content and give all the demonstrations before engaging in laboratory experiences. This approach also has a shortcoming of a low degree of contiguity.

THE PROBLEM

Over the years the cybernetics course has had a great deal of undulation between degrees of success (student achievement and student satisfaction). With smaller class size the teaching of multiple activities was easier, and with larger sizes greater difficulty was encountered. The trend in the department has been larger class sizes for optimal staff utilization. Because of the instability of success, a different strategy was needed, and possibly a different philosophical outlook.

THE SOLUTION

In considering an alternative strategy, the concept of mastery learning was adopted. Mastery learning is a philosophy of the teaching-learning process indicating that many more students can learn at levels that have traditionally been reserved for the "brighter" students. In this system the student is placed in competition with the material, rather than his peers. This learning system can accommodate varying student entry levels and not penalize those with differing abilities in the subject area. A mastery learning system, by putting more emphasis on the mastery of the content, usually reflects higher student grades. A traditional method usually places the students in a normal curve of grade distribution. The mastery learning system, by virtue of its concentration on mastery, places more students in the higher grade levels.

After analyzing several variations of mastery learning (Keller's Personalized System of Instruction and Bloom's Learning for Mastery), the following system of instruction was adopted (Figure 1). The considerations that brought us to this strategy were dictated by the nature of the instructional problem, the content of the course, the personnel involved and the student population.

Figure 1

EPIC MASTERY LEARNING SYSTEM

1. Mastery is considered as performance on post-tests on each module at least 90% accuracy, plus at least 90% on the final examination.
2. Learning modules vary in length and type. Modules can take a few hours or a week to complete. Also they can be separated by either being a "reading module" or "laboratory module" or a combination of each.
3. Sequencing of the instruction is definitely hierarchial in nature.
4. Lectures or demonstrations will be utilized to "inform," "review" or "motivate" and not for presentation of new material.
5. Pacing of the instruction will be provided by the student, but the teacher has options to control rate of student progress.
6. Feedback/remediation for each module will be provided by post-tests that will be graded and the use of tutors, proctors, and alternative resources.
7. The original instruction for each module is presented by either reading materials or instructional media in self-instructional format.
8. In order for a student to move on to a new module, he must either have shown mastery in the material (90%) or receive permission from the instructor if mastery is not shown.

The basic precepts of mastery learning, regardless of the particular variation chosen, state that: all students can and will learn, the instructor must pre-specify the instructional objectives in terms of what is "mastery," the content should be broken into small units, testing devices should be generated for each unit or module, the student has the right to recycle through the material and tests and finally the instructor must grade on an absolute basis.

The heart of any mastery learning system is the individual learning unit, or module. An instructional module should consist of two basic parts: the original instruction and the feedback/remediation component. The original instruction presents the content for the first time to the student, while the feedback/remediation evaluates the student's mastery and recommends corrective activities if the original instruction has proven insufficient. The organization and format of the original instruction is very important, as this is the only communication between the student and teacher in the presentation of the original material. The original instruction is presented, for our application, through reading materials or programmed instructional media. Figure 2 outlines the format of an instructional module used and Figure 3 shows an example of a particular module. Because a

final examination was utilized that tested for performance mastery (laboratory activities) and cognitive mastery (reading materials), the objectives were separated to enable the student to better determine the requirements for each module.

Figure 2

INSTRUCTIONAL MODULE FOR THE EPIC MASTERY LEARNING SYSTEM

TITLE: Module title.

PRE-REQUISITES: What the student must complete in order to insure success in this module.

RATIONALE; The module's intent and goals and why this module is important in the course of study.

OBJECTIVES:

Cognitive: The measurable outcomes as a result of reading articles or viewing media.
Performance: The measurable outcomes as a result of the laboratory activities.

INSTRUCTIONAL ACTIVITIES:
The activities that will help the students attain the objectives. These are specified in order that they should be completed. These may refer to the acquisition of reading materials or instructional media. Also included is the self-test and post-test so that the student can be evaluated in his attainment of the specified objectives.

Figure 3

INDUSTRIAL EDUCATION & TECHNOLOGY

EPIC 291 — MODULE 9

TITLE: PROCESS CONTROL SYSTEM

PRE-REQUISITES: Module 5

RATIONALE: In this module you will apply the knowledge and skill of measurement when you analyze the measuring means. Also you will gain knowledge of a relay as a final control element that manipulates the control variable so that the measured value will match the desired value. In addition, this module will guide you in assembling an actual industrial control system. You will manipulate various components and observe how the system reacts.

OBJECTIVES:

Cognitive:
- A. Identify and explain the functions of the major components of a process control system.
- B. Describe the five basic functions of instruments.
- C. Describe the meaning and purpose of instrumentation.
- D. Differentiate between open and closed loop systems.
- E. Describe and cite examples of four modes of control process variables.

PERFORMANCE:
- F. Given an EPIC II control system, digital voltmeter, hot-plate and temperature charts, the student will assemble and analyze the measuring means, controlling means and generate a chart recording the automatic control system. The data collected will match 90% of the data presented by the instructor as the standard.

INSTRUCTIONAL ACTIVITIES:
1. Read: Instrumentation (IET Media Center)
   Story of Automatic Process Control (Lab Manual)
   Terms of Instrumentation (Handout)
   Relay (Handout)
   EPIC II System (Lab Manual)
2. Lab activity: EPIC II system (Lab Manual)
3. Self-test: Answer questions at the end of Instrumentation plus questions included in the experiment, and definition of terms.
4. Post-test.
5. Recycle or move to next module.

The feedback/remediation component of the modules consists of post-tests for each module for feedback, while remediation usually originates from the instructor, student proctor, or prescribed alternative materials. As in most school situations, the availability of alternative resources is a problem. In this system, however, the instructor can function as an alternative resource because he has been freed from the task of presenting the original materials.

METHODS

The syllabus prepared for this course describes the method used for this strategy.

This course is organized on a modular basis. There are 18 modules — reading and/or laboratory. At the conclusion of each you take a self-test to assess your knowledge. If you are confident that you have mastered the material, then a post-test will be administered. It will contain both multiple choice and short answers. The post-test will be immediately evaluated. If you have achieved total mastery (90%) or acceptable mastery (80%), then proceed to the next module. Now, should you not achieve mastery you may repeat or recycle the module and take the post-test again at no penalty. You may repeat it as many times as you wish to achieve total mastery. When recycling one cannot take a post-test more than twice during a class period.

Lectures and discussion will be at a minimum, with an average of about one per week. The topic will be of a review and synthesis type. Critical information for testing will not be the objective. Therefore, you are not required to attend. There will be no testing of lecture material. However, students have enjoyed the demonstration and discussion. Some found them to be very informative.

The course content is self-paced; that means you set the pace or rate of learning. At the outset there may appear to be many tests, but I assure you this will ease up. A pit-fall for you is to procrastinate, so that mid-way in the course you may not be testing out of modules at a desirable rate. Thus, at the end of the course you could have many modules to master and it could be near impossible. Part of this syllabus is a play-by-play of the rate which modules should be completed. Do not be misled by the titles of the modules, since not everyone can follow this path because of limited learning stations. However, it is important to note that one or two modules should be completed in a given week.

In Figure 4, the path of the student through each module is described to illustrate the sequence of the events to facilitate the completion of each module. Notice that the student is required to show evidence of completion of the self-test before he can proceed to the post-test. This prevents unnecessary test taking and insures that the student has processed through the module.

Figure 4

1. START
2. Review module (RATIONALE, PRE-REQUISITES, OBJECTIVES, INSTRUCTIONAL ACTIVITIES)
3. Are all pre-requisites completed?
4. Complete all pre-requisites.
5. Follow in order the instructional activities as stated in module.
6. Check self-test and experimental data with instructor of proctor.
7. Is self-test and/or experimental data acceptable?
8. Recycle through original material.
9. Take Post-test.
10. Have post-test graded.
11. Is mastery achieved?
12. Recycle through original instruction or alternative strategy (tutor or other readings)
13. Move on to next module.
14. END

THE EVALUATION

In contrast to some research (Block, 1976), more content was not covered by using the Keller Plan of mastery learning. However, the students were more involved in their

assignment. I know they read the content at least once or else they could not perform well on their post-tests.

In general, it is difficult to make comparative studies between a lecture/lab course style versus an individualized course structure. In a modular course, students realize that if they successfully complete a certain number at a given quality they will achieve a C grade. Most of the students completed all of the 17 modules, as compared to the opposite when lecture/lab course was employed. That is, only a few students completed all of the prescribed laboratory tasks.

The same final exam was used for a lecture/lab and the individualized course, with the results favoring the individualized course. The final grade distribution followed the literature, in that more students mastered the content by using individualized modules than those who were enrolled in the traditional lectuve/lab organization.

Reflecting upon the problems of the course — many students and few learning stations, plus low student performance — the utilization of the Keller Plan of mastery learning has alleviated the problems.

OFTEN ASKED QUESTIONS ABOUT MASTERY LEARNING

What About Students Who Complete All Their Modules Early?

Resulting from brief experience with this system of instruction, only a few students accomplish this feat. My only concern or responsibility as a teacher is to have students master the content. If they do master the content in less time, generally because of some prior training, then they may use the time as they choose. Such as, studying for another course, reading the campus newspaper, watching the girls or, as in one case, performing further refinement of laboratory activities.

How Do You Keep Track of What the Students Are Doing?

A progress chart is used which is like a matrix. The left vertical side of lined paper has a listing of names and across the top is the label of each module. Projecting horizontally from the student's name and down vertically from the module labels yields a cell. In the cell the post-test scores are recorded and a TM for (total mastery) or AM (acceptable mastery). The students have a similar progress chart, but less horizontal lines. As the instructor's chart is filled in, so also is the student's. Both have a chart of the progress as well as mastery. Thus, when analyzing the entire class, the instructor has a gauge to identify students who are having difficulty and the activities in which they are currently developing mastery.

How Is Time Scheduled During the Week?

Because of the limited number of learning stations, varying from one to eight, it became necessary to start students at the beginning of the quarter at different points in the course. For example, a group of students will start in one learning hierarchy (Modules 1 through 5) while another group will start on learning hierarchy 6 through 8. Once the course has begun, the students tend to spread out. This is understandable in terms of individual difference of abilities. After three or four weeks into the course, there may be as many as six different activities happening concurrently, such as reading and/or testing in an adjacent classroom, performing experiments, viewing media, reviewing self-tests in small groups, or some students may not come to class because they are progressing ahead of schedule. In essence, once the course starts, the instructor is truly a manager of learning.

Is There Cheating on the Post-Test for the Units or Modules?

Comments from the students are, "We don't have to because we can take the test again." or "There's no need. I am competing with the test and not others." In general, cheating is not a serious problem. Two post-tests have been developed which are equal in reliability and validity. It helps in terms of re-testing, thus eliminating a temptation to memorize the answers. When the course was initiated, only one post-test was developed. As the course evolves, modifications are being made. Another point is the students know that the final exam will be comprised of essentially the same questions derived from the post-tests; therefore, when they master the content, their confidence increases. When the final exam is administered, students are less "tight" because they know they know.

How Can I Evaluate a Mastery Learning System?

A teacher is mainly concerned with achievement and performance abilities; thus, the final exam is a measure of final achievement and performance. The final exam consists of two parts — a cognitive and a performance test given on separate days. From this data the instructor can analyze each module and note, in general, which were effective and which were weak. Close examination of each module in terms of correlation between objectives, direction and content and the post-test can reveal i[illegible]riencies or lack of clarity. These faults are then corrected and tried again. Fr[illegible]tructional technology point of view, the Keller Plan allows for more precise [illegible] of ineffective instruction and greater teacher satisfaction when a module tested [illegible]y effective. The teacher is rewarded for good personal performance.

Do Students Achieve Higher Using a Mastery Learning System as Compared to Traditional Approaches?

If one is interested in comparing the effectiveness of the Keller Plan versus the traditional lecture/discussion, the research is inconclusive and comparison is difficult. Most comparison studies have indicated no significant differences between the approaches. Thus, both are equally effective using the present instrumentation technique, the final exam. This approach may be inappropriate because of different emphasis placed on the final exam. For example, if there are only one or two tests per quarter under the traditional method, 50 to 100 percent of a grade depends on the score; therefore, more "fear of fail" motivation can distort the measured achievement.

Can Students Learn by Themselves?

In essence, all education is self education. Using a mastery learning system allows the student to learn small units of information and/or practice the procedures in acquiring skill without being penalized. A teacher can more quickly identify slower learners and give tutorial help, while those blessed with greater God-given talents can progress at a faster rate. Using a mastery learning system provides for more teacher-student interaction. Also, groups of students work together in mastering modules. There is always interaction between students, since the students are not competing among themselves but with the course content. One could say a team spirit grows. From my own experience operating multiple activity labs, or "a three-ring circus," it seems that many students need help at one time, but with a mastery learning scheme that incorporates modules with objective, direction/content and a procedure for learning the content, a great deal of redundancy of teaching is eliminated. Getting back to the question, students can assume responsibility for learning.

Will a Mastery Learning System Require More Staff?

By virtue of the nature of mastery learning, one professional staff person can handle more students than with a traditional methodology. However, it is important to keep a ratio of about 10 students to one responsible individual for better management of the system. Therefore, student proctors or teaching assistants who work for academic credit or for experience can be utilized to answer student questions, grade tests, and keep records. In essence, the professional staff is constant, but student proctors are needed to handle some record keeping and tutoring.

How Much of the Present Material Can I Use?

You can use much of what you have prepared for your course. But in the process of identifying content for each module, you may find it necessary to reorganize your content and even make basic content decisions. Many practitioners of mastery learning have found it possible to increase the amount of content in a given course in the same amount of time.

What Kind of Instructional Materials Will I Need?

Since the employed system was essentially self-instructional, we needed materials that were designed to be used in this manner. Slide-tapes, filmstrips-tapes, programmed print materials, and videotapes all fit into this category. When considering that each module necessitated the use of some media, the development task seemed like an enormous task. However, we found tht it was wiser to produce a few materials a quarter and integrate them into the course. In this way the tremendous burden of product develop-

ment is lessened and the instructor is better able to assess needs as the system progresses. Because of the individual nature of your facility, your students, and the type of instructional system you choose, it is almost impossible to rely totally on commercially-produced instructional materials. The article "Teacher-Made Media: Coping with Inflation" can be helpful in identifying the kinds of media that would be appropriate for self-instruction and how to produce them. Other sources are listed in the suggested references of this article.

How Can I Control Student Procrastination?

Students working at their own pace is a desirable feature for any instructional system. However, all of us, regardless of our motivation, have a tendency to procrastinate, and students are no exception. The teacher as manager of the learning activities must have tools to prevent this eventuality. One strategy that we have used successfully was to announce completion dates as a guidepost to the student. This gives the student an idea of how far he should be in the course in order to finish the material on time. Another technique was to announce question/discussion periods on certain topics. Although our system depends on student-pacing, we are cognizant of the responsibility of the instructor to manage the learning activities for all of the students.

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Historic Restoration

Harrison Goodall

A number of years ago I gave a presentation at an AIAA Convention on the topic of automated drafting. It was a time when I and many others in our profession were vitally concerned about newer developments in computers, automation and data processing. Many of us were trying to keep current with technological advances in an attempt to provide relevant instruction to our students.

Somewhere between then and now, I made a giant step forward in this area of relevancy by taking a giant step backward. This step forward has led me to my most stimulating and challenging level in education. The giant step backward began when I directed the restoration of a 165-year-old carriage house. Since that time, I have had three such projects, with one more scheduled for June. I am thoroughly convinced that they are the

most rewarding courses I have ever taught. The students have also stated that they have been the most valuable educational experiences they had had.

DETAILS OF THE PROJECTS

Since enrollment in all of the projects has been limited, students must apply and be accepted by me before registering for the course in "Historical Restoration," which is an official academic course at the college. The length of the course and the amount of credits is based on the complexity of the activity. Students pay the appropriate tuition and fees and provide for their transportation to and from the site. On all previous projects the host has provided for the meals, lodging and insurance. In addition, the host has provided all materials and whatever tools and equipment we were not able to supply.

With the preparation and organization so extensive, the projects are identified and selected as much as a year ahead. So far, all of the activities have been with conservation centers and all of the preliminary historical research and design has been done by me.

PURPOSE

It would seem that the primary purpose of this program is to learn about how to restore and reconstruct historically significant structures, but this is not the case. Rather, I have found that this type of activity creates an atmosphere in which students can learn about themselves, about others, and about their environment. These goals are more important to life. The challenge of building a log cabin or of moving a carriage house combined with the daily interaction of living and working together becomes the media by which people learn about people. More specifically, I'd like to identify the merits of the program as follows:

RELATING TO THE GROUP

People of different backgrounds, ages, and levels of ability come together to work on these projects for as long as four weeks. Initially they are strangers to one another, but by living and working together in a cooperative atmosphere, the group becomes supportive of one another. Leadership abilities in individuals emerge and teamwork begins. In a very short time they become a cohesive, efficient working and social unit developing a sense of camaraderie and group identity.

EXPERIENCE PROBLEM SOLVING

Construction, particularly as it relates to historical restoration, is an excellent media through which to develop problem solving techniques. Since the experiences are generally new to everyone, the art of common sense has to be practiced on its most basic level. In the day to day activities, there are countless opportunities for individuals and small groups to have solutions to problems such as "What is the easiest way to get this bent down?" or "How do I sharpen the adze?" or "What type of mortar was used in this chimney?" or "How should we identify all of the pieces of the building before disassembling?" These projects provide the opportunity to identify and solve large and small problems, make decisions, and be responsible for carrying out their solutions to an end in a very practical and realistic way.

AWARENESS OF THE ENVIRONMENT

Working outdoors for an extended period of time in a natural area creates a keen awareness and sensitivity to our enviornment. Instead of racing by the wilderness, we are living in it and can relate much more closely with the dependency of one thing on another. Also, in a very different sense, the relocation and restoration of an old building is an attempt at reviving some of the past environment for the future.

RELIVING THE PAST

There is no better way to learn about what it was like to live in the past then to relive it. Reconstructing an old structure using the same tools, techniques, and materials

does just that. Students take on the role of the original builder, develop a deep respect for his craftsmanship, and begin to appreciate the complexities of life long ago as compared with how we live today; a very direct way to establish reverence for our heritage.

EXPOSURE TO DIFFERENT PEOPLE AND AREAS

The upcoming restoration in Canada is a good example of how the students will be exposed to different people and different areas. During the four-week stay the group will have numerous opportunities to explore Southern Ontario and to talk and relate to the people.

SELF DISCOVERY

Without question, the most important aspect of the restoration program is self discovery. There is no better way for a person to learn about himself than to observe himself as a functioning member of a group with a common cause. By comparing and relating to others, individuals are able to discover and identify abilities and traits they themselves never thought they had or would have. In addition, they are brought in touch with their own limitations and find healthy ways to deal with them. Under these conditions, it is also easy to appreciate and respect each other for their individual skills and abilities.

Restoration also provides an excellent media for people to learn basic construction skills and develop a high level of confidence and self satisfaction in the process of creating. Working, eating, sleeping, playing and living together provides a learning situation which they may have never before experienced. It is indeed a unique opportunity, and it would be difficult to think of a better way or even an alternate way to foster all of these positive learning experiences.

SERVICE TO THE HOST

In addition to the personal benefits of the participants, the host has been provided with a service they may never have been able to afford or accomplish. With only the cost of materials, meals and lodging, our hosts have acquired some very valuable structures.

OUTCOME

The enthusiasm of the participants in these projects has been overwhelming. They become totally involved in the activity to the point where what they are doing is not for someone else; rather, the structure is theirs, individually, a part of themselves which is to remain for others to see and admire. Their sense of accomplishment along with all of the other experiences will provide memories which will remain with them through life. They are not only proud of their craftsmanship in creating something which is so substantial, but can leave knowing that what they did was good; good for them, the host, the college and for all the people who will use the structure.

To me, it is possible for a program like this in historic restoration or just in field construction to be offered to students at many colleges and high schools across the country. There are structures all over which are in need of repair. Generally parks, camps, and conservation centers have many buildings which desperately need attention. Numerous cities are choking with houses in need of renewal. Even urban homesteading is becoming a viable way of reviving some sections of our cities. Historic societies have long lists of sites which need restoration.

The opportunities exist; it just takes some imagination, a lot of enthusiasm, and a phenomenal amount of time to initiate and carry out a project. The result, however, could be your most rewarding and exciting educational activity . . . ever.

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University Honors Seminars and Special Options Available to the Honors Student

Larry Olsen Hatch

Every student in the honors program is to have a unique program suited to his or her needs. This individualized program usually will branch in one of two directions. That is, a student can greatly broaden his or her experience or narrow in on a particular area of strength. To accomplish this, the honors program at Iowa State has developed special educational experiences for its members. Honors students have several privileges and opportunities not open to other students.

Iowa State offers some 30 honors seminars every year. This is especially noteworthy when it is realized that no arrangement is made for instructor released time except as they may arrange with their department heads. For the most part, the instructors are donating their time to an activity which they believe to be of benefit to both the students and themselves.

Most honors seminars meet once each week for an entire quarter, usually for one and one-half to two hours. They carry one or two credits, depending on the amount of out-of-class time the student is expected to invest. Nearly all honors students participate in at least one seminar during the year, and many in more than one.

These seminars are usually limited to less than 15 honors students. One of the goals of the university-wide seminars is to bring students together from every field. Also, they provide honors students with educational experiences in fields not directly related to their majors.

The Industrial Education Department at Iowa State University has provided special honors seminars among industrial education honors students. These seminars are conducted along the same lines as all seminars; however, they are of particular relevance for the student in this major. In these seminars, students are often asked to present a topic or program. Sessions include panel discussions, guest speakers, presentations of honors projects and field trips. Activities range from exploring educational research to the completion of individual resumes. Over-all, the industrial education honors seminars are a place to develop and test out a philosophy of industrial education.

Several other options are open to the honors student. The students are not locked into a structured program, allowing a flexibility not available in conventional programs. The following are some of the ways programs are developed:

1. Changing regular courses to honors courses.
2. Deleting required courses and substituting more meaningful courses.
3. Skipping an introductory course in order to take a more advanced course.
4. Courses may be taken pass/fail.
5. Enrolling in honors courses (e.g., Honors English).

The honors student has two other privileges that can be taken advantage of: Research grants and extended loan of library materials.

Although the honors program is to be flexible and individualized, each student must meet certain minimum requirements which are determined by each college committee. Within this framework, the options available allow the honors students to meet their goals by either broadening their educational experience or developing specific areas of strength.

The Fitchburg Plan: The Thematic Approach for Studying Industrial Technology

Everett N. Israel

Before 1972, much thought had been given to the revision of the industrial arts curriculum by the industrial arts faculty and concerned Fitchburg State College adminis-

trators. Their viewpoints, when placed along a continuum, ranged from making minor modifications in the existing curriculum to developing a completely new curriculum.

During the fall semester of 1972, an Industrial Arts Curriculum Coordination Committee was formed. Their task was to determine the nature of and procedure for revising the curriculum.

The industrial arts faculty agreed that a major curriculum revision was needed. Specifically, they recognized that the revision must meet future societal and cultural needs while maintaining those unique, effective characteristics of the present curriculum. This goal was achieved by (1) identifying a list of assumptions relative to the future; (2) surveying students and alumni to identify unique and desirable characteristics of the on-going program; (3) investigating trends in higher education and in industrial arts; (4) identifying a procedure for revising the curriculum and (5) developing a curriculum model. These tasks were completed by the end of 1972.

During 1973, the industrial arts faculty finalized the over-all curriculum goals, identified major and minor areas of concentration, defined universal themes to depict man's technological endeavors, and specified goals related to each of the universal themes. The above was accomplished through the assistance of James J. Hammond, Chancellor of the Massachusetts State College System, and Dr. Paul DeVore, Professor of Technology Education, West Virginia University.

Student learning experiences were described during the third year. These experiences were written in the format of competency statements.

SOCIETAL AND CULTURAL NEEDS

The planning of the curriculum involved making predictions about the future. Among the many social and cultural needs that could be predicted, the ability for man to deal with change was deemed of prime importance. With this as the central thought, the following assumptions were formulated:

1. Change will be continual.
2. The rate of change will vary, depending upon other social and cultural factors.
3. Society will be technically oriented.
4. Education will play a significant role in enabling man to understand and cope with change.
5. Continual change creates the need for education to be a life-long process.
6. Knowledge will consist of intellectual processes as well as theories, facts, principles, and concepts.
7. Man will play an important role in making decisions that will have an effect on the process of change.
8. The ability to make decisions will be critical.
9. Problem solving will involve the application of interrelated bodies of knowledge.
10. Problem solving will involve the identification of variables and the projection of their effects on life.
11. The process of continual learning will be dependent upon knowing one's self and how one learns.

Man's ability to understand change will have an effect upon his physical, social, and psychological millieu, as well as determine his ability to deal with change. Hence future citizens will need to develop a better understanding of the causes and processes of change, the ability to identify and/or predict problems and the interdisciplinary application of knowledge to solve problems.

UNIQUE FEATURES OF THE PRESENT CURRICULUM

Alumni and student surveys were conducted as a means for evaluating the present curriculum. The results designated some unique features as well as areas that needed further investigation.

Unique features identified by the alumni survey were the broad scope of the program, the empirical learning approach, and the performance-based personal learning atmosphere. Graduates specified that these factors, along with other personal qualities, enabled them to enter a number of related professions: guidance counselors, supervisors of industrial arts and occupational education, vice-principals, principals, college faculty members,

college presidents, salesmen, technicians, furniture designers, and managers of companies, just to name a few.

Other unique features designated by alumni and students were the development of technical skills, the use of the unit approach for planning courses and the application of the thematic approach for planning curriculum. The unit approach involves the use of a theme, problem, or central idea to interrelate subject matter and activities. The organization of courses and learning experiences around a central idea that depict man's major technical endeavors is known as the thematic approach.

The results of the surveys identified some areas that needed further exploration. Students and graduates suggested that the revised curriculum should include: (1) field and/or industrial experiences, (2) more educational theory, especially as it relates to knowledge about children, (3) an in-depth study of how to organize courses and industrial arts programs, (4) new approaches for handling discipline problems, (5) the latest thoughts regarding school administration and organization, (6) instruction on how to make more effective use of the instructional media, (7) a performance-based, clinical teacher preparation experience, (8) provisions for students to explore areas of interest in laboratory courses and (9) laboratory maintenance.

TRENDS IN HIGHER EDUCATION

The latest trends in higher education were identified. Each was researched to determine its purpose and effectiveness in achieving its purpose.

A further in-depth investigation was completed if the trend was related to the assumptions and results of the surveys previously specified. Trends that were researched are as follows:

1. Interdisciplinary Approach: means of achieving an objective in which the person or persons seeking the objective interrelates and applies consciously or unconsciously the knowledge, methods, materials and apparatus of more than one discipline.
2. Thematic Approach: the use of broad general topics dealing with man's experiences to plan units of instruction which integrate different subject matter areas and activities.
3. Educational Professional Sequence: a sequentially ordered set of theories, methods and clinical experiences designed for preparing prospective teachers.
4. Performance-Based/Competency-Based Teacher Education: a concept whereby the effectiveness of teacher education programs are evaluated on the basis of performance rather than on judgment in terms of grades on a specified number of required courses.
5. Institutional Cooperation or Consortium: an arrangement where two or more institutions — at least one of which is an institution of higher learning — agree to pursue between or among member institutions, a program for strengthening academic program, improving administration, or providing for each other's special needs.
6. Module: an operational framework for organizing educational experiences to meet the needs of students (module instruction, module units of time, module scheduling).
7. Open Access Institutions: a non-traditional study program where elements of change, flexibility or organization, adaptability to individual needs, increased options and open entrance and exit prevail.

The need to apply interrelated bodies of knowledge to solve problems and the nature of technology prompted a thorough investigation of the interdisciplinary and thematic approaches.

Research into the professional sequence and performance-based/competency-based teacher education trends provided insight into how these approaches could be combined for the preparation of teachers. Also, the investigation provided impetus for completing an in-depth study of different learning theories and styles, with special emphasis upon affective learning, concept learning and problem solving. The different learning styles and individual needs might be accommodated by the implementation of a modular instructional framework or an open access system.

TRENDS IN INDUSTRIAL ARTS

Major curriculum decisions were made by the industrial arts faculty during an extensive in-service education program. These decisions were based upon a review of major contemporary trends in industrial arts.

One national trend studied was the expansion of industrial arts programs to prepare students for the teaching profession or industry. Because the subject matter for both offerings was related, the faculty accepted the challenge to offer a second major. This created the need for renaming the present Industrial Arts Department to the Industrial Technology Department. The decision was based upon many factors. First, the scope of our present program has enabled students to become successfully employed in industry. Second, the addition of the second major would further broaden the scope of the program. Third, the industrial arts laboratories could readily accommodate the education-for-industry (industrial science) program. Fourth, the education-for-industry concept would enable industrial arts students to become more technically oriented. Fifth, industrial science courses, presently offered during the evening, could be scheduled during the day and in the evening. Finally, industrial science offerings would provide the opportunity for industrial education students to explore other career possibilities.

The second trend investigated was the development of a variety of industrial arts and industrial education curriculum plans since 1960. Special emphasis was placed upon identifying similarities and differences among the models.

Before 1960, the rationale and means for implementing industrial arts as part of general education were formulated. Industry was identified as the subject matter of industrial arts. Misuse of the project method for teaching industrial arts resulted in widening the gap between theory and practice. Thus, activity became the major criterion for identifying course goals and determining content. The latter created the need for the re-evaluation of curriculum emphasis. This resulted in the development of many different curriculum projects.

A review of the major curriculum projects ascertained a common procedure for planning a curriculum. Each (1) identified and defined the subject matter, (2) used a system or scheme to structure the subject matter, (3) formulated over-all goals, (4) identified broad fields of study, (5) specified learning experiences and (6) designated a plan of action.

The industrial arts faculty chose to employ the above procedure for revising their curriculum. They felt the procedure would result in students developing a better understanding of a body of knowledge: that is, the students would understand (1) how their subject matter area interrelates with other bodies of knowledge, (2) interrelationships among the elements of the body of knowledge, (3) the relationship that exists between theory and practice and (4) how new knowledge is developed and applied.

Major differences among the curriculum plans reviewed were related to (1) the subject matter identified, (2) the scheme or system used to structure the subject matter and (3) the broad fields of study. Bodies of knowledge identified were technology, praxiology, industrial technology, American industry, and industry. Taxonomies, classification systems, subject matter "maps," hierarchies, matrices and system analyses were employed for structuring subject matter. The broad technical fields identified were communication, construction, manufacturing, production, transportation, production, energy and power.

The faculty selected technology as the body of knowledge. They defined technology as man's efforts to cope with his natural and man-made environment through his imaginative and ingenious use of available resources to meet man's needs and wants through the production of goods and services. This definition depicts man as a developer of techniques that are used to cope with or control his physical environment. The development of techniques requires man to apply knowledge and create it within the confines of the resources available. Man's application of techniques has an effect on the physical environment and his social and cultural millieu.

Technology was selected as the body of knowledge for three reasons. Since technology exists in a social-cultural setting and is a major source of change, the students' understanding of technology will enable them to better comprehend the world they live in and to cope with change. Secondly, technology will add new dimensions to the traditional material and manufacturing based industrial education programs and place new emphasis upon developing creative, intellectual endeavors of students. Third, the interdisciplinary nature of technology will create the need for forming interrelationships with other bodies of knowledge. These new interrelationships will identify new avenues of learning for students to explore.

Another trend investigation was that some colleges and universities offer courses concerned with the study of technology to the total student population. These courses

provide the opportunity for students to develop a better understanding of the world in which they live.

A thorough investigation of this trend resulted in the faculty recommending that this curriculum proposal include courses that students could elect to fulfill their general education requirements. These courses, being interdisciplinary in nature, would enable students to develop an understanding of technology and its effects on society. Special emphasis would be placed upon making students aware of the role human values should play in making decisions in the use and control of technology.

STRUCTURING A SUBJECT MATTER

The industrial technology faculty agreed that the body of knowledge, technology, should be divided into two major areas: the Technological (Big T) and the technical (small t). This decision was based upon previous work completed by Dr. Paul DeVore.

The Technological area (Big T) denotes those common characteristics about technology that have evolved throughout man's history as the result of developing and using techniques (small t) to meet his material wants and need. These characteristics or attributes of technology were present in the past, are present now, and are expected to exist in the future. Some attributes of technology are as follows:

1. Technology is created by man.
2. Technology is cumulative in nature.
3. New technology replaces, displaces and adds to past technology.
4. Technology solves old problems, but creates new ones.
5. Technology determines the nature of man's work and life.
6. The application of technology has an effect upon society and culture.

The faculty selected the conceptual hierarchical system for structuring the attributes of technology. These characteristics, if placed along a continuum, would range from those that have general application to a large number of situations to those which would apply to specific situations. The continuum provides a means for students to acquire knowledge which will enable them to achieve higher levels of abstraction as they develop a better understanding of technology. Also, the conceptual system would enable students to acquire an understanding of technology by investigating areas of their interest.

The conceptual system was selected because it would enable students to comprehend (1) how technology functions, (2) man's technical areas of endeavor, (3) how technology has an effect upon society and culture and (4) how the effect of technology might by hypothesized.

The students' understanding of the characteristics of technology will result in their becoming aware of the effect it has upon the role of work, consumerism, and areas of avocational interest. The students' understanding of these areas will enable them to live a more productive life.

The thematic approach was selected for organizing subject matter related to the technical aspect (small t) of technology. Based upon in-depth research completed by Chancellor James J. Hammond, materials, transformation, energy and communication were identified as central themes for classifying man's technical endeavors. Related to each of the areas it is understood that man is a designer, a craftsman, a technician, a developer, a researcher, an organizer, a manager, a problem solver and a decision maker. This system is similar to the major technical aspects specified by Dr. Daniel Bell. He identified function (purpose), energy, communication and control, fabrication, and algorithms (man's intellectual means for making technical decisions) as major technical areas of endeavor.

For each technical area, the faculty chose to employ the system which would best structure the body of knowledge. The scheme that has been employed for each area is specified later in this paper.

CURRICULUM ASSUMPTIONS

The following assumptions were formulated for determining the over-all nature of the revised curriculum and its parameters.

1. Education is a life-long activity.
2. Continual learning is dependent upon knowing how one learns.
3. There will be continual change.
4. Technology is a major force that causes change.
5. Man's understanding of technology will help him cope with change.
6. Man's ability to solve problems and make decisions will have an effect upon technological change.
7. Major characteristics of technology can be identified and organized.
8. Students' understanding of these characteristics will enable them to understand better the world they live in.
9. Man's technical endeavors can be identified and classified.
10. The thematic approach depicts man's major technical endeavors.
11. The procedure used to revise the curriculum depicts the interdisciplinary quality of technology.
12. The common core will result in industrial education students developing an in-depth understanding of technology.

The structure of the proposed curriculum revision was based upon the following assumptions. The curriculum:

(1) structure will provide opportunities for the establishment of interdepartment programs.
(2) structure will provide opportunities for interdisciplinary application of knowledge to solve technological problems.
(3) structure will establish a harmonious relationship between theory and practice.
(4) will include a common core for all industrial technology students.
(5) will provide a means for all students enrolled in the college to become aware of the effect technology has upon society and culture as part of their general education.
(6) will provide opportunities for the total college population to elect industrial technology courses.
(7) will provide time for industrial technology students to explore various career choices.
(8) will prepare industrial technology students for immediate entry into a career area of their choice subject to limitations of curriculum offerings (technical related careers).
(9) will allow industrial technology students to elect courses in their selected career dependent upon their interests, needs and professional requirements.
(10) will allow industrial technology students to investigate an area related to their selected career.
(11) will include a field experience in the career area chosen by the industrial technology student choice.
(12) will be competency based.
(13) will employ the module organization of learning to accommodate for individual differences.
(14) will enable students to develop their intellectual capabilities.
(15) will employ different instructional strategies, each one selected based upon desired outcomes.
(16) will emphasize the unit approach for planning industrial technology learning experiences in public schools.
(17) will include a clinical based/professional sequence for preparing industrial arts teachers and industrial technologists (industrial science majors).
(18) will incorporate the use of paraprofessionals.
(19) will employ the team approach and the "house within the house" concept for organizing faculty.

CURRICULUM GOALS

The curriculum will enable the students to:

1. acquire an understanding of Technology (Big T): how it defines the role of work, and its effect upon society and culture.
2. become better consumers and explore new avocations.
3. acquire an understanding of the major technical endeavors of man (small t).
4. understand and experience the process for developing and applying technical knowledge.
5. explore different technical career areas.
6. select a technical career area based upon their self realization of their abilities and interest.
7. develop competencies which enable students to be employable in their selected technical career area.
8. select and investigate a related career area.

CURRICULUM MODEL

The industrial technology curriculum consists of a technology core, a technical core, and a career preparation core. All students enrolled in the college will have the opportunity to acquire an understanding of technology by taking courses in the technology core (Big T). Emphasis will be placed upon students' understanding the attributes of technology, the part technology plays in defining the role of work, the effect technology has upon society and culture, and how to live a more productive life in a technological society.

All students enrolled in the industrial technology program will be required to take the common core. It consists of the technology and technical core. In addition to the study of technology previously outlined, the student will understand man's technical areas of endeavor and how technical knowledge is developed and applied. They will also have the opportunity to explore different technical career areas.

For each technical field (material science, communication, energy and transformation) students will (1) conceptualize the area, (2) engage in technical experiences which exemplify the scope of the technical area and (3) explore possible career choices related to each area.

After students have selected a major, they will meet with an advisor to determine their technical areas of specialization. The selection of their areas of specialization is based upon their interest, their needs and professional requirements. For example, students majoring in industrial arts may specialize in communications and transformation. After they have completed the three required courses in each area, they may select competency-based courses offered in each of the areas, (e.g., photography, offset printing, photocomposition). As the result of the students' selecting industrial arts as their major, competency-based/professional sequence is required.

The structure of the curriculum model was designed to respond to change. New areas of technical endeavors can be added as man develops them (i.e., transportation). The competency-based curriculum insures that students will acquire and apply knowledge. The use of the mini and mod arrangement allows students to pursue areas of interest, as well as allowing students majoring in other programs to elect courses in the industrial technology program (e.g., technical problem solving, visual perception, printed circuit board, integrated circuits, photography, welding).

Dr. Israel is Curriculum Coordinator, Industrial Technology Department, Fitchburg State College, Fitchburg, Mass.

Practical Approach to the Teaching of Cabinetmaking and Building Construction for Prospective Teachers

Roger L. Keep

The topic being presented today is the practical approach to the teaching of cabinetmaking and building construction at the university level. In other words, preparing prospective teachers to teach cabinetmaking and building construction when they get out in their respective teaching assignments.

In teaching cabinetmaking and building construction, there are several methods that are used today. Three of these methods are the lecture/discussion approach, the model building approach and the practical application approach. The lecture/discussion approach consists basically of instructor-directed lecture presentation and instructor-directed discussion. Included also in this approach would probably be some field trips and guest lecturers. This approach or method is basically classroom oriented or situated. The model building approach to teaching cabinetmaking and building construction is much the same as the lecturer/discussion approach with the exception that scale models of cabinetry or construction projects are used to substantiate and clarify the material from the lecturer or discussion. The practical application approach to teaching these areas also uses lecturers and discussion, including field trips and guest speakers. The method used

to amplify and clarify what is taught is the actual or practical experience. This would consist of the students in the class actually building or constructing cabinets and/or buildings.

The first two methods used, lecture/discussion and model building, depend very heavily on a transfer of learning in order for the student to teach these areas in the future. By transfer of learning, I mean learning something theoretically or by imitation and trying to apply this knowledge to the real thing. This statement is not to criticize the transfer of learning concept, because this is something that we have to depend on a lot in education. The thought here is, would we be better off and more effective in our teaching of these students if we can teach them the real thing on a first-hand basis? This is what the practical application approach to teaching cabinetmaking and building construction is all about.

The rationale, or major objective, of using the practical application approach is to teach the areas of cabinetmaking and construction as close to the real world as possible, thus reducing the transfer of learning theoretical base to the "I know how" level. This is done, as mentioned, by having the student participate actively in constructing things, either cabinets or buildings.

The major justifications for this approach are twofold:

1. Interest — as has been shown time and time again in industrial arts and vocational education programs, students like doing things in the labs as contrasted to the things done in a classroom. The practical application approach emphasizes hands-on and doing things.
2. Motivation and Application — the things just mentioned as why students are interested in this approach are major reasons why they are motivated toward it. People, including students, become motivated in things which are useful or pertinent to them individually or personally. It becomes useful to them because of the possible application of the things learned. The practical application approach relies on the principle of vocational teaching, yet is not geared to teaching specific vocational skills. However, a certain level of skill will be developed purely by the teaching approach that is used. The application of the skills for the student is the ability for them to use them for their future teaching or possibly for monetary gain.

As you can see, the two points of justification for this program are closely aligned. Additional justifications for the practical application approach are in existence but will not be discussed at this time so that the actual procedures and mechanics of using this approach can be identified, which is the major part of this presentation.

The first step in implementing this program is to advertise what your classes are attempting to do. For us at Cal Poly, this advertising consists of a letter sent to all deans, department heads, maintenance and building personnel explaining what we are doing and describing the types of jobs we would like to have for the classes. Included in this letter is a statement to the effect that all materials have to be supplied by the department or school requesting the job. There is no charge for labor; that is part of the learning process of the respective classes. Generally, the best place to find cabinetmaking jobs is from home economics and administrative type of offices such as the admissions office, records office and deans' offices. The best place to find building construction projects on our campus is from the Agriculture Department. Any jobs that come in related to building construction have to be approved by the executive dean in charge of facilities and usually by the campus planning committee. Building construction projects really need to be lined up at least a quarter in advance so the approvals can be received in time.

At this point, let me separate the two types of classes and first discuss the cabinetmaking class. The responses from the letters soliciting cabinetmaking jobs are held by the instructor until the class actually meets for the first time. The students are then given the memos relating to the jobs. They check with the individual who is requesting the work and develop the initial design and rough drawings of the project. At the next class meeting, each of the students presents the job that he checked out for the class to decide on the ones that most accurately fill the goals and objectives of the cabinetmaking course. After this is done, a small group (2-3) of students will draw the plans, develop a materials list and construct a cost sheet for the projects. These materials receive the approval of the instructor and are submitted to the individual requesting the work for his final approval. Changes may then be made and the material for the project is ordered.

This procedure gives the students an opportunity to work with the public in determining needs, the kinds of materials to be used, how much the project costs and the opportunity of ordering materials. During this time, basic cabinetmaking principles and practices are discussed. When the materials are received, the students construct the cabinets. This includes finishing, delivering and installing if necessary. During the quarter, periodic discussion sessions are held to insure that theoretical knowledge is developed and learned.

The procedure for the building construction class is a little different than the procedure just discussed. Here, it is necessary for the plans to be initially drawn and then submitted to the Executive Dean of Facility Planning and the Campus Planning Committee for approval. This means that the planning stage has to be done prior to the quarter in which the construction class is taught. After the approval is received, nothing further is done until the class actually begins. At that time, several of the students draw the final set of plans, develop a materials list and order the materials. The week to 10 days which it takes to get the materials is spent in in-class discussion, presentations and films relating to building construction practices. One very unique activity that is done at this time is a simulation game of estimating.[1] A brief explanation of this simulation game is as follows. Part of the class is divided into three groups of three each who represent contractors. The remainder of the class is divided into smaller groups of two who serve as sub-contractors. The contractor group and the sub-contractor groups are given a set of plans. The sub-contractors bid on plumbing, roofing, electrical, sheet rock and taping, lathe and plaster, painting and floor coverings. The contractor usually figures foundation and slab, framing, sheet metal, windows, doors, trim, counters, appliances and fixtures and may also bid on heating or may let that go to a sub-contractor. Each group receives a sheet of instructions as to how to estimate different materials, a set of plans and current costs. Each of the groups of three contractors and their sub-contractors are bidding to get the individual job and are competing against each other. The game is judged by an inspector who has a set of figures for each area which represent the high and low amounts required for completion. Each group is also judged and either given a bonus or points taken from them, depending on their completion time for constructing the house. This simulation game will usually take from three to five hours. Interest in this game is extremely high, and in testing it was found effective for teaching estimating.

At this time, the materials have arrived at the job and the students begin work. They normally dig footings, form and pour the foundation wall or slab, frame the building and put in any windows and doors. They also do the interior and exterior siding, wall coverings, and the roof. Normally the jobs that are selected for this class can be completed in one quarter. Similar to what happens in the real world, the head carpenter, plumber or electrician on campus (who serve as building inspectors) will make periodic inspections prior to continuing the different phases of the job. For example, the carpenter and the plumber will check all forms and rough plumbing prior to pouring a slab.

In conclusion, having taught this approach for the past eight years, I have found that from the point of view of the students, it is the only way to go. From the faculty member's point of view, it is far more difficult to teach and organize the classes this way, but the extra effort is worth it. Rather than drawing conclusions from this presentation and expounding on them, let me ask a few questions that hopefully will draw conclusions from you. Possible questions that come to mind are:

1. In your opinion, do you feel university students preparing to teach industrial arts need practical experience? If so, how do they get it?
2. Can the necessary basic information and/or adequate theoretical base be developed using the practical applications approach?
3. Do you feel this approach is an effective way of teaching cabinetmaking and building construction?
4. Does this teaching method have application in other areas of industrial arts than cabinetmaking and building construction?

REFERENCE

1. Green, Dwight. "The Learning Effectiveness of Simulation as Compared to Lecture in the Subject Area of General Contracting in the Building Trades." Master Thesis, California Polytechnic State University, 1973.

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Improving Preparation of the Industrial Arts Teacher

Charles Kiker and Steve Simonson

The theme of this conference, "From Heritage to Horizons," issues the challenge to reach new heights in all education. Teacher preparation is probably the most challenging. We offer this presentation, "Improving Preparation of the Industrial Arts Teacher," for consideration of its applicability to your own programs.

An increasing number of public four-year colleges and universities are offering technical occupational programs below the baccalaureate level. This was indicated by a recent study conducted by Eastern Kentucky University in cooperation with the American Association of State Colleges and Universities and the National Association of State Universities and Land-Grant Colleges. One of the central questions arising is: "What competencies must an effective instructor, the industrial arts instructor, possess?" For purposes of this presentation, let me simply define a competent instructor as one whose graduates are competent on 80 percent of their job. To achieve that high standard, each instructor must know what he or she will do and how it will be done.

The program that I will describe effectively prepares air force technical instructors to achieve at least that percentage of graduate competency on the job.

The Air Training Command has more than 3,500 courses to prepare Air Force men and women for employment in a wide variety of careers. We develop the over-all curriculum and prepare our own occupational instructional materials.

It is not practical for the Air Force to provide English, mathematics, history, psychology, communicative skills (or related education) when there are accredited colleges readily available where airman are stationed. We do plan the total curriculum, but rely on civilian institutions for much of it.

Education and training for the vast number of Air Force members entering and progressing through career programs demands well-planned curricula. This is to save your tax dollars.

We, of course, need competent and dedicated instructors to conduct this large volume of instruction effectively.

Most personnel selected for instructor duty have from 3 to 10 years of job experience and are highly proficient in their field. But how will they perform as instructors in the classroom?

In order to answer that question and meet the need for qualified experienced technicians who are also competent technical instructors, the Air Force designed a concentrated course of up to six weeks and three days duration. The course is divided into two blocks of instruction. Block One is four weeks three days in the classroom, and Block Two is two weeks of practice teaching. It is simply called The Technical Instructor Course, or "T.I.C." Graduates are awarded a badge signifying that they possess the competencies required of their new profession.

Here are some of the broad topics that are covered in the course. Some of you probably remember these general areas from your own teacher preparation program.

The learning processes taught in this course are condensed from a number of reputable sources and include:

Laws of Learning
- readiness
- effect
- frequency
- recency

Patterns of Learning
- rate
- association
- insight
- reasoning

Theories of Learning
Communicative Skills

Instructional System Development

1. Analyze System
2. Define Education or Training Requirements
3. Develop Objectives & Tests
4. Plan, Develop, Validate Instruction
5. Conduct & Evaluate Instruction

One significant element of this course is the Air Force model for instuctional system development, or ISD. Throughout the entire course we stress the instructor's role in this approach in developing and conducting instruction.

In other words, the course teaches how new system requirements or changes to a present system are identified through the use of job inventories and task analyses.

Because the ISD approach is rather unique, I shall spend more time talking about it than about the more conventional portions of the instructor course; then we will continue with other elements of the course.

The Air Training Command instructional system development (ISD) is the most effective plan we have to provide efficient and adequate instructional materials. The model we follow helps us answer these questions:

What do we teach?
- which courses
- what are the specifics needed in each course

How do we teach it?
- general
- specific

How do we know when we have taught it?
- measure
- application of principles
- achievement of each objective
- performance

ISD is taught briefly in the instructor course and more thoroughly in an intensive 160-hour course. We will condense it to about 20 minutes. One PhD who had heard this five or six times said that he had just realized the scope of its meaning.

In mid-October 1975, I was surprised to find a long-lost friend working for the largest construction company in the South. The company's size is reflected in 5 billion dollars in backlogged contracts.

The friend was employed as an administrator in their technical-occupational training program; I believe they call it "Crafts and Trades." He was employed because they specifically wanted an ex-Air Force educator.

My first thought was, "Friend, your Air Force education is out-dated." I began trying to tell him what had happened since he left the service. He was courteous, but he found time to introduce me to members of his staff who let me know that they kept contact with our people who are at cutting edge of our educational developments.

The company education and training programs are based on the USAF ISD model, including those taught in foreign countries to foreign students.

The first step is to analyze the system. The scope of this survey determines the scope of your planning. It should yield information for the complete curriculum as well as for specific courses. When we adopted the term, "system" meant the man in his work environment with his equipment. For example, an X-ray technician with his X-ray equipment, laboratory and patient. We are concerned only with education and training of the man or woman — not the equipment and environment.

Step one is accomplished on a large scale by personnel in the research division, Air Force human resources laboratory, and the occupational measurement center, both at Lackland Air Force Base.

Information about realities in all careers is gleaned from Air Force members all over the world. This information is shaped into job inventories and task lists, and from these standards are developed. The standards (job, specialty, course, etc.) broadly define the knowledge, skills, and characteristics required. The standard further prescribes proficiency expected at the various levels, entry, qualified, supervisory, and superintendent.

Education and training required for any given career require a well-designed curriculum. The Air Force provides the occupational or technical portion of any given pro-

gram, and that would normally consist of several separate courses. This series of courses is fused into one meaningful, logical sequence.

SOURCES OF INFORMATION

Our graduates and their supervisors are valuable sources of information. They know which portions of the courses are less than adequate or more than adequate and what should be added or what is taught but not needed.

Industry provides advice and counsel. Civilian and military educators given constructive recommendations. Career consultants for each career area, noted educators and labor representatives give much aid. Manufacturers' instructions on new products and equipment also help.

DEFINE REQUIREMENTS

With this information, we can better define the education and training requirements. This does not mean that every item must be taught. Several factors are considered in determining what is taught and what is left for on-the-job training.

Let me remind you that this step is interconnected with other steps. In every part of the process there must be a bit of evaluation, decisions, or at least thought given to the methods, content, media and measurement. Every step is related to each of the others.

DEVELOP OBJECTIVES

If we don't know where we are going, we are liable to end up some place else. The third step of ISD is where we determine just where we are going.

We decide what is essential and what is excess to the needs, limit the nice-to-know information and probably delete the war stories, family problems, etc. Well-defined objectives help guide learning activities toward realistic goals. Developing objectives is perhaps the most difficult and most critical step in the ISD process. We must determine just what the student must do to demonstrate that he is competent or that he has attained the objective.

CRITERION MEASURES

I was of the old school in which grades were expected to be well distributed over the normal bell curve. Something gradually changed my attitude, and now I consider criterion testing acceptable.

The student can or he cannot do a specific task. I am less concerned about whether he cannot do the task better than some other student cannot do it. Our testing is based on criterion-referenced achievement.

VALIDATE INSTRUCTION

My Opinion – Not Necessarily USAF

After the objective and criterion test items are developed, the next task is to design instruction to enable the student to pass the test. That may sound very non-traditional, but if the objectives are realistic and the test is valid and comprehensive, why couldn't the instruction teach the test? Just be sure the test includes all the objectives.

SELECTION OF INSTRUCTIONAL METHODS

Selection of methods depends on several factors. Which of the following will enable the student to be successful in his apprenticeship?

Hands-on Experience	Demonstration
Slide Projections	Discussion
Performance	Lecture

Instruction must be fitted to the student body like a tailored garment is fitted to an individual. With all our ideals, however, we are limited by time and resources.

Selection of the method applies to each step of instruction. Even after the curricular materials are developed and set in motion, if a student has trouble, the instructor takes

a new approach — demonstrates, explains, and tries again. Each student reacts as an individual and has his own peculiar stumbling blocks. The live instructor with the system gives a hand whenever/wherever need is recognized.

MEDIA

A rule of thumb is: Use whatever strengthens communication. Shall we use multimedia? A single medium? Real equipment? Combinations? Actually, these decisions are made for each step of instruction.

Every one of the best ideas in instructions are tested before they are incorporated into the system. Thus, the instructor has the information, suggested audio-visual materials, methods of presentation and everything else needed to make the course effective. The instructor can add or interpret or alter to fit the needs of the class.

VALIDATION

Bits of instruction are tested on wives, husbands, fellow workers and others. Then small units are tried with small groups. Larger segments are tried on groups, and finally the completed block or unit is tried on a group or groups.

This part of the ISD process can be very frustrating. We can develop seemingly perfect instructional programs, but when we try them on students, there may not be much learning. If there isn't much learning, there is something wrong with the instructional system, not necessarily the student. Pride of authorship leads one to believe the students are less than capable.

After realization that our materials do not teach as much as we expected, after the disappointment and reaccomplishment of the instructional materials, tryouts of little segments of the course may be made with individuals and segments, or complete units may be tried out with small groups. When we are satisfied with the entire course, it is then conducted and tested with a real class — or validated. This proves that the course will (or will not) teach what it is supposed to teach.

The initial impact of new course materials on instructors and students may simulate a small tidal wave, but their reactions and evaluations help to refine the course materials. From experience, I find that most deficiencies can be found during the "first time" use. Instructors gradually learn to compensate for deficiencies and errors; after several times, even glaring errors are forgotten.

EVALUATION

Now the course is in operation, and we could think that we would have only minor changes. A very real test comes now. Evaluation, as we know it, is made up of two distinctly separate categories: Internal and external.

Internal evaluation doesn't mean exploratory surgery. It is conducted in Air Force schools constantly. This evaluation is conducted by those who have a vested interest in the operation of the school, and they consider facilities, instructional materials, supplies, equipment, quality of instruction, student's participation, student's achievement and everything else that affects instruction.

Along with all this, student critiques are conducted. Students are free to express their favorable and unfavorable comments. The instructor frequently conducts his own private critiques between the scheduled critiques; thus he can very well determine how his course is sailing before he goes by any check points.

Additionally, there are curriculum specialists who conduct course reviews to insure updating and adequacy of materials.

External evaluation is accomplished by evaluation teams which visit the school, graduates and their supervisors. Team members are people who are not directly affected by the results of the evaluation.

Also, there is a scholarly and systematic procedure for obtaining evaluation information from graduates and their supervisors through mailed-out questionnaires. This type of feed-back comes from every area where graduates are assigned. When warranted, instruction is changed accordingly and expeditiously. We accept recommendations.

The cycle begins anew and is repeated as deemed necessary and appropriate. This instructional system development helps the instructor by providing the most efficient, complete instructional system that the Air Force has been able to devise.

We have talked more about development of instructional systems than we have other portions of the technical instructor course. We shall now continue with other elements of the course.

STUDENT PRESENTATIONS

We have talked about methods more than we have talked about oral communication. In the instructor course, a number of controlled practice teaching exercises are distributed throughout the first block of instruction in order to give the student teachers confidence and practice in planning for and using the skills they are acquiring. Completion of these exercises may be by stand-up instruction or, if appropriate, the designing of self-paced lessons.

Of course, the subject of the student teacher's presentation can be related to his actual job and becomes a learning experience for the entire class. For example, the student teacher of automotive mechanics might use the objective he had previously constructed in his module on writing behavioral objectives (e.g., replacing all the gaskets in the Ford 1560 carburetor). In actual teaching situations, 80 percent of the students must perform the task correctly for the teacher to have successfully completed a demonstration/performance lesson. However, in practice teaching, demonstration of the appropriate skills for the methods used is more relevant to the learning situation.

We tailor the course to fit the needs of the students and to use the communications media we have available. In our classrooms, various student presentations are videotaped by the instructor to help the student become aware of and corredt any distracting mannerisms he might have and is perhaps unaware of (example: rattling change in pockets, poor eye contact, etc.). All is designed to give the student the required competencies to lead a discussion comfortably or use proper questioning techniques in his class.

Practice teaching exercises are critiqued by the instructor and the other student instructors. Critiques include commenting, generally, on the planning of the presentation (clarity, organization and content) vs. the effectiveness of the actual delivery of instruction (delivery, interaction and evaluation).

Of course, replay of the video can help pinpoint areas of weakness and show subsequent improvement. Or the video could even be part of a demonstration lesson within a self-paced presentation module for the instructor to evaluate.

Upon completion of the first block of instruction, the student teacher is placed on the job in the department where he will be an instructor for two weeks of supervised practice teaching.

We are presently validating a self-paced version of the course at one of our technical training centers. This method reinforces the idea that there are desirable alternative ways to present material other than the straight lecture method.

We are working on methods for teachers to learn how to manage self-paced instruction. We have become accustomed to the lecture method or reading a newspaper while students struggle with problems in self-paced instruction.

Learning modules have been prepared for the content areas previously covered. The student has up to four weeks three days to complete the first block of instruction. A number of people with some previous experience or training in education have completed Block One in as little as five days.

With successful completion of the two weeks of practice teaching, the student teacher is certified as a technical instructor and is awarded his instructor badge.

However, the new instructor then works with an experienced instructor until he has mastered each unit or block of instruction for which he will be responsible. When his assignment changes, he again co-teaches with an experienced person until he has mastered or "checked-out" in his new subject.

IN-SERVICE TRAINING

To insure that the proficiency of our technical instructors remains at a high level, they must attend at least one in-service training course a year in subjects such as:

- Academic counseling
- Audiovisual methods
- Development of learning objectives
- Instructional system development
- Tests & Measurements
- The instructor's role in self-pacing.

This entire educational program is directed toward the improvement of educational communication in our courses and assures that our graduates are increasingly more qualified to perform on the job.

At the present time, portions of the technical instructor course are being used by several educational institutions in their faculty development programs. For example, Appalachian State University has modified the course to meet a similar need within the North Carolina Community College system.

If you are particularly interested in obtaining a copy of the technical instructor course or one of its related in-servi training courses, I have an address to write to obtain them. They are available — as are all courses in the over 90 program areas of the community college of the Air Force. Public or non-profit institutions may receive a copy at little or no cost through our curricular materials exchange program.

To believe the results of the total system of instruction, you must see it. I strongly recommend that you arrange to visit one of the major schools.

Keesler AFB, Mississippi
Lowry AFB, Colorado
Chanute AFB, Illinois
Lackland AFB, Texas

Better yet, visit us at the CCAF headquarters, Randolph AFB, Texas.

I know of no technical/occupational courses prepared with more care and expertise than these. Let me repeat that we develop the complete curriculum, but prepare courses only for the specific career.

They are essentially yours for the asking. Your tax dollars paid for our ISD process.

If you have comments, questions or requests, you may write to the Community College of the Air Force, Professional Relations Division, Randolph AFB, Texas 78148.

Mr. Kiker and Mr. Simonson work at the Community College of the Air Force, Randolph AFB, Texas.

The Scope of Honors Education

William L. Larsen

The idea of honors education is old, having roots that reach back into liberal arts education of many years ago. In its modern form, it is perhaps best represented by the National Collegiate Honors Council, which came into existence in 1966 as an outgrowth of an earlier organization, the Inter-University Committee on the Superior Student.[1]

The NCHC serves as a forum and communications link for honors programs in the United States, but the programs themselves are extremely diverse. There is no one standard definition of honors, but one might, without being too far wrong, refer to it as superior education for superior students. This superior education has as many forms as there are campuses upon which it is found. Even the concept of what constitutes a superior student or superior education is not well defined.

It is appropriate — as well as being inevitable — that a high degree of diversity exist among honors programs. Each is set in its own context with its own needs, opportunities and resources. Coupled with this is a group of faculty and students on each campus, all of whom are trying to create new structures, new educational methods, new content. Honors is ultimately limited only by the imaginations of those involved in it. Nevertheless, its character on any given campus usually can be related to the traditions, needs resources, constraints and attitudes within which that program finds itself.

Contrary to a common conception, honors programs do not exist for the purpose of conferring honor upon students. Any student who enrolls in an honors program for purposes of enhancing his or her reputation or self-image does so for the wrong reason. The term honors does cause problems in interpretation and, some schools have dropped the term, even while retaining their program. However, in most of the schools where both the title and the program remain, there is little thought of conferring honor. Rather, the sentiment is that some measure of honor may be earned through some form of academic achievement which is not usually even attempted by the ordinary student.

The academic processes by which superior education is achieved are many and varied. No one campus has an honors program which embodies all the possible variants. To give some idea of the possibilities, a few examples are listed here.

Honors courses may be accelerated, advanced or enriched. Honors faculty recognized very early that superior students were being short-changed by being held back to the academic pace set for average students. Skipping of pre-requisite courses and immediate placement in advanced or graduate courses enable the student to learn at whatever pace he or she is capable and to get farther in a given period of time.

One of the interesting consequences of this form of educational experimentation was the recognition that many alleged prerequisites were found not to be prerequisite at all, but rather served such purposes as keeping a class together, easing scheduling or providing balanced teaching loads. At the worst, it was sometimes found that the course was not even needed but had outlived its usefulness to all but the professor. Another revelation was that we sometimes taught too much fact and too little understanding of principles. No student can begin to assimilate all the available, or even important, facts. However, some courses exist for the purpose of dispensing information — a task which might well be left to books or relegated to self-learning. Some teachers learned that if they taught concepts, the students could move at a faster pace, could find the facts for themselves, could cover more concepts during the term, and, perhaps most important, could see their education as learning how to learn. The student who can see the conceptual structure of the subject, as contrasted to only the facts, has the capacity to learn beyond the scope of the course, to become a self-learner, to see and create new concepts, and thus achieve a whole new dimension of understanding. Accelerating learning in honors courses taught us a great deal about our regular courses, as well as teaching the student a much more creative approach to education.

Enriched courses sometimes covered no more ground, as ordinarily measured, but they offer greater breadth. Thus, while a student may not learn to solve any more problems in an enriched physics course, he may learn a great deal more about the history of physics, the lives of great physicists, or the social and philosophical impact of the ideas of physics. Such contextual breadth is the hallmark of the educated person, one with the capacity for creativity, one who may see new implications and applications of knowledge, as compared to the technician who is merely skilled in the performing of prescribed work. Enriched courses often open doors to vast new storehouses of knowledge.

Honors courses may be experimental in content or method. Would the student really understand the subject better if we used a different text, or developed a time-honored formula from a new perspective, or if we eliminated a traditional topic and replaced it with a new done? Very often, honors courses represent creative teachers' attempts to improve the content of their course. Typically, and happily, if the experiment is a success, the "new" course may be adopted as the standard and all students benefit. This is a frequent occurrence in honors teaching.

Methods, too, can be improved. It seems that the trend is away from traditional lecturing — which is heavy on information transmittal — and toward Socratic methods or interpretive and analytical lecturing based upon facts the students can read or find for themselves. The variety of methods of teaching known to the academic community is large; the number of methods actually employed is often small. This is dictated, in part, by habit as well as by convenience. Honors sections of courses are usually small, 15 or 20 being a customary maximum for a course, 10 to 12 for a seminar. Given that size of class, creative teaching methods become possible.

Honors education is often individualized. Honors faculty usually recognize that students vary in their goals, needs and talents. They frequently also find that the needs of a profession or of society are not well served if every graduate has the same training. Therefore, after completion of a basic core of knowledge required to meet minimal professional requirements — a core which tends to get smaller the longer and more honestly

looks at it — the honors student often embarks in new directions or makes new combinations of old elements.

This flexibility has long been one of the marks of honors education, particularly in curricula such as engineering, education, home economics, etc., where by tradition the degree of specification has been high. In the case of engineering, for example, there has been a strong trend in recent years away from the highly specified, rigid curricula. In part this has been brought about by the accrediting agency which has recognized that diversity and breadth are essential to the education of a person who must be creative and flexible in the application of his knowledge and in responding to social needs. It has also been found in some cases that local interpretations of accrediting criteria have been unduly and unnecessarily restrictive, being more nearly a reflection of tradition or individual bias than of the real needs of the profession. Thus, through the privilege of flexibility granted to honors students, the faculty has found that other students' curricula may be unnecessarily restrictive. The result has been a loosening of many requirements to the benefit of all. This same effect is being felt in areas other than engineering.

Flexibility applies to individual courses as well as to whole curricula. Individual study is widely practiced in honors programs on occasions when class attendance is really not required, when the student can profit from pursuing ideas different from those covered by the regular class, or where there is need to study material not embodied in existing courses. Such individual effort often is manifested as research projects, special creative works, off-campus field work or intensive investigation of special topics.

Honors study often is carried out in a seminar format. Topics are frequently those of current national or international interest, though there are also many seminars exploring well defined topics that are off the beaten track or which represent the frontiers of knowledge of existing disciplines. Some features of such seminars are student freedom in the selection of both the topic and the instructor and exploitation of the benefits of group discussion. Student-student interaction can often perform academic wonders that faculty-student interaction can achieve. Often the instructor is in the position of guiding a loosely-hitched team of energetic horses. He usually succeeds in keeping them going more or less in the same direction and out of the mire, but the pace and directions are often set by the students. Under such circumstances, the honors programs often achieve their greatest successes.

In addition to such tangible aspects, an honors program often provides very important and real but intangible benefits. Frequently there is superior advising by faculty — or even by upperclass students — who wish to share in the excitement and concern of helping a promising student plot a course for himself. There are social benefits to the students who frequently find a feeling of encouragement and support from those of similar ability and interest. It is often found that the awareness of competition diminishes among honors students who are grouped together, and this is replaced by a feeling of cooperation. Along with this goes a decreased emphasis on grades, per se, with a consequent increase in actual performances and in the pleasure of learning.

Other features of some honors programs include common housing, as in an honors house or honors dormitory; emphasis on foreign travel, public service or work internships; preparation of an undergraduate thesis; or privileged access to research, library and learning facilities. The list is large, ever changing, and not likely to be identical at any two institutions.

Very little has been said here about grades, admission to honors programs or required standards of performance. Again, practices vary widely. At a recent meeting of honors students from three apparently similar institutions at which the honors programs are greatly different in character, the students all came away feeling that each institution had criteria and procedures suitable for its own students and circumstances. Such variability and the satisfaction with various forms will doubtlessly continue.

Some of the variability stems from a lack of agreement as to the proper criteria for selection. Some criteria which are widely used are high school grades, high school rank, early college grades, SAT scores, ACT scores, interviews, quality of written applications, written or oral examinations and tangible evidence of scholarly achievement.

On the other hand, exit criteria also vary widely and may include enrollment in certain courses, maintenance of certain grade levels or completion of specified projects or theses.

Despite all these enormous variations, a convention of honors students — which is in itself a delight and an education — reveals a remarkable unanimity of enthusiasm and

dedication to high goals, along with evidence of high personal character, abundant creativity and energy and a feeling of comradeship in building and enjoying an educational experience based upon one's own dreams. I would hate to lose our honors students, but I would be delighted to have those from almost any other honors program.

At Iowa State University there is a vital, growing, productive honors program. It is perhaps unlike any others in that there is essentially an independent program in each college, independence in terms of some admission criteria and in the form and content of the programs of individual students. While on the one hand being adapted to the differing academic environments in the several colleges and while having some courses and opportunities peculiar to that college, all the programs are tied together at the top and share a common purpose, general policy and pool of courses and seminars. For us, the system appears to have all the advantages of any system and few of the disadvantages. Of course, we are also constantly changing, and we hope improving. One recent major change has been the institution of Freshman Honors Program, and another has been a considerable broadening of course offerings.

The details of our program are not important here, how er. What I wish to point out is that we have a dynamic, flexible and growing program that we hope will be responsive to the needs of each of the several colleges within our university.

As I view the potential for honors work in a college of education and more particularly within the context of industrial education — whether it is called industrial arts, industrial technology, industrial education or some other name — I see several exciting possibilities which may not be fully developed at all schools and which your honors program can help bring about.

First, I see the possibility for productive exploration of all the ramifications of psychokinetic learning. Other than a few psychologists who may have thought about it, most faculty people in other disciplines have thought education to be essentially a cognitive process. Nothing could be further from the truth, as you well know.

As a laboratory teacher I know I can achieve results that are impossible with other modes of learning, but I am not sure why. Perhaps the creative thinking and research of honors students in industrial education will help me learn.

Too often teachers in other disciplines regard laboratory work only as a means of illustration of concepts or discovering or proving concepts; that is, the laboratory work is the tool of the intellect. I believe this is fundamentally wrong, ar at least short-sighted.

Working with one's hands can be a way of creating and shaping the concept. Why must it be that only the eye and the ear are channels for input to the brain? I conceptualize about the operation of my car by handling it. Cannot we use controlled manual experience as a way of actually forming and interpreting concepts?

Industrial education stands at the interface of the workman and the work. Has the understanding of the interface been fully achieved, or is there still some tendency to think too much about the worker and his skills as one separate entity and the product of the work as another? If one wishes to take a popularized view of this subject, I would strongly urge an honors seminar built around the book, "Zen and the Art of Motorcycle Maintenance."[2] Although I have some reservations about the book, I am very enthusiastic about its treatment of the interaction between a worker and work. We can all profit from reading these views.

Another dimension of this area is that of worker satisfaction as contrasted to worker performance. What is the subjective nature of work, and how does it affect both the worker and his work? What is really involved in a job enrichment program? When does manual work become craftsmanship and art, as for a skilled dentist making restorations? Is this important in planning or doing work? Is a foreman or engineer really competent to direct the work of others if he has not experienced — as opposed to thought about — the work?

Those who are engaged in the application of tools have an opportunity to perceive and feel the impact of technology on people and on our way of life that in some ways is more profound than the perception or feeling of the computer engineer or nuclear physicist. Although we worry about the impact of computers and radiation, neither of these act directly at the sensory level. We have a vastly different perception and feel about the tools of the shop. Yet, in their day they had some of the same impact on life as more sophisticated tools do now. The particulars have changed; many of the principles are the same. Can we learn something from industrial education about the interaction of man and technology?

Finally, what is the effect of industrial arts or industrial technology on our esthetic and ethical values? Does the ability to create a St. Louis Arch or a welded sculpture affect our concept of art? Does the stone carving of the Eskimo or the rug of the Navaho carry with it a message concerning the religious or ethical values of the artisan? How about a modernistic rendering of one of our own religious symbols? Can we divorce our material works from our values, both esthetic and ethical?

I would like to suggest that within the realm of industrial education there is a unique opportunity for honors education, not just as a means of fulfilling the traditional ends of honors which I have already outlined, such as curricula flexibility, opportunity for creativity, interdisciplinary breadth, subject matter enrichment, etc., but also to explore presently undeveloped areas. I would think it exciting to sit down with the top students in my departments and inquire into questions such as the potential of industrial arts as a humanities course, the potential for promoting psychokinetic learning, the philosophical implications of craftsmanship, the social dimensions of industrial work, and the affective dimensions of a discipline which is too often considered only as a developer of skills.

I hope as you hear about some of the ways an honors program has been implemented in an industrial arts context, you will consider what your honors program can do to help you provide superior education for your superior students.

FOOTNOTES

1. The secretary of the National Collegiate Honors Council is Dr. C. Grey Austin, University Honors Director, The Ohio State University, 9 Denney Hall, 164 W. 17th Avenue, Columbus, Ohio 43210.
2. Robert M. Pirsig, Zen and the Art of Motorcycle Maintenance, Wm. Morrow, New York, 1974. Also available in a paperback edition from Bantam Books, Inc., New York.

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The Student Teaching Supervisor's Role—Identifying Teacher Competencies

Donald E. Moon

As it is the primary responsibility of the classroom teacher to guide the learning activities of children, the primary responsibility of the student teaching supervisor is to guide the learning activities of the student of teaching. The supervisor, as the leader, interacts with the students of teaching in the classroom/laboratory situation, both as individuals and as a group. In the process of this interaction, he influences the students, sometimes intentionally with planned behavior, sometimes consciously without planning, but often without awareness of his behavior and the effect of this behavior on the learning process. The supervisor, then, is continually exerting influence on the student of teaching and indirectly on the learning situation.

The areas of influence are numerous and vary considerably from institution to institution. Under this system of evaluation, one of the most important responsibilities of the college supervisor is to properly administer the several components of the system. The following items summarize the college supervisor's responsibilities:

1. Communicate program objectives and evaluative procedures to students and cooperating teachers.

   The nine categories of teaching competence that will be described in greater detail in this presentation define the objectives of the field practicum. The supervisor seeks to clarify their meaning for the participants. Often, this entails adapting them to specialized areas of instruction or unusual circumstances.
2. Plan with district staff an appropriate schedule of training experiences for students.

Here, the supervisor deals with decisions such as:

a. Time for actual teaching by the beginner.
b. Time for lesson planning.
c. Time for weekly seminars with students of teaching.
d. Time for systematic observation of teaching by the student.
e. Time for observation of and visitations by the student with building support staff specialists, librarians, counselors, social workers, psychologists, etc.
f. Time for department, faculty and PTA meetings.
g. Time for community exploration, visits to other buildings.

Although the student teacher is expected to devote full time to his/her school assignment, without becoming involved in other course or part-time employment, the activities planned for the student must not represent an overload.

3. Guide appropriate pacing of the students' training during the quarter.

Students of teaching will differ in how much responsibility they can successfully accept at different periods of the quarter or semester. When is a student ready to plan and teach a lesson? *What kind of a lesson? A unit? Plan and teach for a full day? For a full week?* These are very important decisions. The answer to each depends to a great extent on the individual, the cooperating teacher, and the nature of the learning groups. The supervisor is in a key position to encourage individualized pacing.

4. Complete at least three "rounds of measurement" and four "observation cycles."

The system of evaluation being presented in this paper emphasizes assessment of a sequence of instruction (unit) rather than merely isolated lessons. Thus, using the Measurement of Student Teaching Performance form, the supervisor reviews and assesses the planning for at least three units of insturction. Similarly, using the form the supervisor reviews and assesses the student's evaluation of those same units of instruction.

As part of a "round of measurement," the supervisor schedules at least one formal observation cycle. A pre-observation conference should be scheduled to review the lesson plans, taking particular note of their relationship to the unit objectives. Regardless of the format used, unit plans and lesson plans should be a part of the field practica.

The second stage of the observation cycle, the actual observation of teaching, varies in length, depending upon the nature of the lesson and the content being presented. The Measurement of Student Teaching form should be used during the observation. The presence or absence of the relevant performance criteria should be noted and appropriate comments jotted in the "Notes" section. The final stage of the observation cycle is the post-observation conference. The reverse side of the form used in observation constitutes a record of the conference. Items of particular strength as well as weaknesses are discussed. Suggestions and specific plans for improvement are made.

5. Schedule, plan and lead weekly seminars with all assigned students of teaching.

These are scheduled on a day and at a time which has minimal conflict with other commitments of participants. Seminar objectives promote achievement by students of the nine categories of teaching competence. Starting with the first performance criterion, the seminar proceeds, in sequence, to identify the problems experienced by the student in applying these criteria in their individual teaching situations. By discussion, students exchange suggestions for solving these real problems. At the end of the quarter, a seminar session involving students in evaluating their practicum experience, and shared with the student teachers preparing to go into the program in the succeeding period, has proven to be an excellent means of getting the students to respond to their practicum assignment in an objective manner.

6. At mid-quarter and at the end of the quarter, report the results of the systematic evaluation of each student's performance.

This evaluation system, more than most, demands a substantial documented record of student performance. While normative judgments are not eliminated, the evaluation process can be smoothed out if data is properly gathered and recorded. Rather than reporting on a "bad-good" continuum, this system reports on the basis of the frequency with which a student demonstrates expected skills. Such judgments will be more easily made if adequate data are kept. Both mid-term and final evaluations should be the result of three-way conferences involving the student, cooperating teacher and college supervisor.

CATEGORIES OF TEACHING COMPETENCE

Three broad views of teaching have been used to generate nine categories of teaching competence. These nine categories constitute the framework for the program. They are:

A. The Process of Teaching
1. Formulates clear learner objectives.
2. Collects and uses diagnostic information.
3. Selects strategies and activities.
4. Uses productive management/interaction procedures.
5. Evaluates the effectiveness of instruction.
B. The Purpose of Teaching
6. Learners make educational progress.
C. The Role of Teacher
7. Maintains positive relations with professionals.
8. Maintains positive relations with learners and parents.
9. Exhibits commitment to the profession of teaching.

These nine categories do not include everything a teacher might do. Purposely, they have been limited to those dimensions of teaching which are applicable without regard to subject, grade level or teaching situation. Further, each of the nine categories is complex and difficult. Each has been subdivided into specific criteria which, when consistently performed, constitutes mastery of that category. These criteria do not apply just to beginners. As shared, common responsibilities of all who teach, these criteria are the responsibilities of all professional practitioners, regardless of experience.

The nine categories of teaching competence reflect different ways of thinking about teaching. In assessing teaching competence, it is essential to distinguish among the purpose of teaching, the process of teaching and the role of the teacher. Failure to consider all three perspectives of teaching skews the resulting assessment or evaluation.

The Purpose of Teaching

The teacher must provide learning opportunities that produce a desired change in pupils. In short, it is to produce learning. There is substantial discussion and dispute as to what learning opportunities are appropriate and what learner changes represent appropriate teaching objectives. But the fact remains that society compels youngsters to attend school for the purpose of improving their knowledge, skills and attitudes. Accordingly, one part of the assessment of teaching must incorporate an attempt to document the results of learning, i.e., in terms of these knowledges, skills, and attitudes. Category six, "Learners make educational progress," relates to this view of teaching. This category suggests that teachers should be held accountable — but only in part — for demonstrating that their pupils have made gains in the direction intended.

The Process of Teaching

Understandably, many are reluctant to assess teaching only in terms of learning outcomes or results. As in all things human, teaching is inexact; the causal connection between teacher behavior and pupil learning is not completely understood. Generally, a surgeon is not held legally responsible for a patient's death if generally accepted medical procedures have been followed. Too many variables can intervene to conclude with certainty that the surgeon was at fault. Similarly, many variables are at play in teaching that are simply beyond the control of the teacher. Therefore, much of the assessment of teaching focuses on the process of instruction that the teacher has adopted.

Teaching categories one through five summarize the process of teaching. These categories are the logical derivatives of accumulated experience and research. They focus on the generally accepted cycle of teaching — the preparation for, implementation and evaluation of instruction. Nonetheless, it is quite possible that a properly planned, executed and evaluated lesson or unit of instruction will not result in significant learning. So long as the student of teaching analyzes the teaching process and attempts to determine why the purpose of teaching was not achieved, he or she may be judged to have performed quite competently in the first five categories of teaching; the process of teaching.

The Field Service Program has gone beyond the mere naming of nine categories of teaching. Specific performance criteria have been identified for each category. No doubt, the adequacy of these criteria may be debated. Professionals will disagree as to what processes are proper. However, all professions — medicine, law, accounting, engineering — have generally accepted processes and procedures for achieving their purposes. Despite some disagreement, each profession can state a set of processes that a large majority of its members will accept.

The Role of the Teacher

A third way to look at teaching is in terms of the expectations that society and the profession impose on the personal and professional behavior of teachers. Despite desirable learning outcomes and the use of generally accepted teaching processes, a teacher's effectiveness may be enhanced or impaired by his or her ability to interact with colleagues, pupils or parents. Therefore, an essential third perspective of teaching focuses on the way in which an individual responds to the reasonable expectations of others. Categories seven through nine deal with this view of teaching.

Implications for Students of Teaching

The Field Services Program attempts to incorporate all three views of teaching into the assessment of a student's work. All students should expect to have their work viewed from the perspectives of "Did the pupils learn?" "Were generally accepted teaching processes used?" and "Can the student satisfy the expectations that society and the profession impose on teachers?" In the broadest sense, then, the objectives of all student teaching programs are twofold:

1. To provide a student of teaching with an opportunity to practice, refine and repeatedly demonstrate competence in all of the stated categories of teaching; and
2. To document for the state and the profession that the student of teaching has demonstrated sufficient competence to warrant granting a license to teach.

THE OPERATIONAL MEANING OF THE NINE CATEGORIES OF TEACHING COMPETENCE

Each category of teaching competence will have operational meaning for the student of teaching when:

1. He/she can recognize the competency when he/she observes its practice in a real teaching situation.
2. He/she can judge how well the competency was demonstrated when he/she observes its practice in a real teaching situation.
3. He/she can demonstrate it in a real teaching situation when needed.

Categories of Teaching Competencies — The Process of Teaching

COMPETENCY ONE: Formulates Clear Learner Objectives

This relates to what a teacher wants to accomplish. There is an important ethical principle of consumer protection involved here. Learners have the right to know what the expected outcomes of daily lessons and teaching units are. Objectives should be clear and specific (observable or measurable) in order to permit teacher and youngster to know when they have been achieved. In addition, objectives must be appropriate or justifiable in terms of existing educational goals, the age and grade of learners, and the philosophy and values of the community.

Criterion 1.a.: Objectives were clearly stated.

The teacher provides pupils with statements of objectives for both daily lessons and units in terms which the students can understand.

Criterion 1.b: Objectives provided a daily focus for teaching.

Without clearly stated objectives, daily teaching strategies and learning activities often become ends in themselves rather than means to a planned outcome. Objectives must be the determinant of teaching strategies and learner activities.

Criterion 1.c.: Objectives reflected the program goals of the subject area.

By maintaining compatibility between course goals and specific unit or lesson objectives and by making this relationship known to learners, the teacher helps learners to see how the parts contribute to the whole. Poor performance on this criterion is often reflected in the following question asked by students: "Why are we doing this?"

Criterion 1.d.: Objectives included both simple and complex learning outcomes.

The teacher provides learners with opportunities to go beyond simple recall to apply what they have learned to new situations and to develop and defend their own solutions to problems.

Criterion 1.e.: Objectives considered attitudes and physical abilities as well as thinking skills.

The teacher's instructional program includes objectives focusing on intellectual activity, attitudes and motor development.

COMPETENCY TWO: Collects and Uses Diagnostic Information

Diagnosis, as a function of instruction, requires that you initially and continuously gather information that allows you to make the best possible decision about objectives and activities for each individual learner. Also, keep in mind that such diagnosis should include the learner as a collector and interpreter of information.

Criterion 2.a.: Identified learners' entering level of performance.

The focus in on the learner. What performances and knowledges does the learner have relative to the lesson to be taught?

Criterion 2.b.: Prerequisite skills and abilities were identified.

As oposed to 2.a., this item may be viewed as content-related. That is, what must any child know in order to profit from the lesson? What are the prerequisites of the content to be taught?

Criterion 2.c.: Information was collected, using formal and informal procedures.

Teacher uses formal and informal testing and observations to determine what knowledge and skills students possess in an area prior to introducing it.

Criterion 2.d.: Diagnostic information was used in adjusting units and lessons.

Objectives are revised in light of new information regarding the limits of learners, and strategies are altered in response to changes in the learners' moods and attitudes as well as abilities.

COMPETENCY THREE: Uses Planned Strategies and Activities

Selecting appropriate strategies and activities is a broad function of instruction that takes place after the instructor has formulated program objectives and has gathered diagnostic data about each learner. With clear and appropriate objectives and sufficient diagnostic data, the instructor is in a position to deal with questions of how, when and with what?

Making educated guesses or hypothesizing have been suggested as terms that summarize what is involved in this function of instruction. The teacher predicts that a certain set of activities will work and uses subsequent measures of learner performance as the test of that prediction.

Thus, there are two classes of competencies involved in this function. One is that of making the initial selection of activities (the educated guesses) or determining how to go about choosing among the myriad of possible activities, materials, and strategies. The second has to do with insuring that the activities and strategies include sufficient opportunity for evaluation, since that is the ultimate test of the appropriateness of the strategies and activities.

Criterion 3.a.: Strategies fit the stated objectives.

As much as possible, the methods the teacher uses should permit the learner to develop and demonstrate the objective to be learned.

Criterion 3.b.: Strategies accommodated alternative learning styles.

The teacher provides or suggests different learning methods to attain stated goals and accepts appropriate student-initiated methods.

Criterion 3.c.: Used some strategies that promote creative thinking.

Different student responses (divergent outcomes) often are the most appropriate teaching objective. This contrasts with the more frequent objective of having students respond with the same answer (convergent outcomes). Lessons and units should regularly include some such strategies.

Criterion 3.d.: Strategies included all elements of a lesson (motivation, involvement, feedback, practice and summary).

Each lesson should include each of these components. The student should have a clear reason for omitting any. The criterion is satisfied only when all elements are included or their absence is adequately explained.

Criterion 3.e.: Strategies reflected teacher's mastery of subject being taught.

A lesson is completed without teacher referring to a text or similar resource, student questions related to the subject matter are correctly answered, and the teacher can elaborate about the topic.

COMPETENCY FOUR: Uses Productive Management/Interaction Procedures.

This competency requires you to begin mastering a rather large and diverse repertoire of skills — some of which are rather universally used (e.g., questioning, verbal reinforcement, corrective feedback, classroom management and pacing skills). Other skills

are somewhat unique to a particular strategy or activity (e.g., lecturing, inquiry, laboratory experiments and demonstrations).

Criterion 4.a.: Physical environments promoted efficient learning.

The instructor must realize that different learning experiences can best take place in different learning environments. As a result, the instructor must not be afraid to manipulate the setting.

Criterion 4.b.: Instructions and procedures were understood by learners.

Instructions must be given in a clear, precise manner in a climate that is calm. Thus, efforts must be taken to see that students are attentive and responsive while succinct, thought-out announcements and directions are given.

Criterion 4.c.: Voice, language and physical bearing promoted efficient learning.

The teacher's voice carries well and features a variety of tonal qualities which help hold interest. Oral statements are delivered dynamically — with obvious energy and enthusiasm behind them. Language is carefully chosen but not uncolorful. There is awareness that new vocabulary can be taught in the course of a lecture or discussion without making too much of it. The teacher's posture and physical presence indicate health and vitality.

Criterion 4.d.: Instructional materials were appropriate to content and strategies.

The teacher provided pupils with an adequate and suitable variety of materials and equipment which made possible and enhanced the learning of the skills, understandings and attitudes to be attained.

Criterion 4.e.: A calm, productive learning environment was maintained.

The teacher assumed responsibility for selecting strategies which were effective in structuring classroom activities and which encouraged efficient and orderly pupil learning to occur. Disruptive behavior is minimized.

Criterion 4.f.: Learners felt free to ask questions and make comments.

The teacher provides opportunities and time for individual and group concerns, comments and questions. By the teacher's open and responsive manner and respect for pupils, the latter want to ask questions and make comments.

Criterion 4.g.: Pacing of lessons was flexible, related to learner needs.

Teachers must be flexible, knowing when to slow down, speed up or make a detour. When plans or strategies are changed, the teacher has a reason that makes sense. Objectives and strategies must be carefully planned in terms of the probable time it will take to achieve or implement them.

Criterion 4.h.: Self-direction in learning was promoted.

The teacher provides opportunities for self-selection, self-pacing, self-evaluation to individuals and groups to promote self-direction in learning.

COMPETENCY FIVE: Evaluates the Effectiveness of Instruction

The effective teacher always asks and tries to answer the question: "Is my instructional program resulting in progress (desirable change) on the part of each learner?" It is irresponsible not to take the time and effort to determine the effects of a well-planned instructional program. The five competencies dealing with the process of teaching are intended to bring about the systematic development of increasingly more effective instruction for all kinds of learners under a variety of conditions. But the two categories of competence central to viewing the teaching as a process are the evaluation of instruction and formulation of appropriate objectives for learners.

Criterion 5.a.: Both formal and informal evaluation procedures were used.

Evaluation of instruction involves both student and teacher. Teachers will provide instruments for formal evaluation and provide situations for informal evaluation. Evaluation will be continuous throughout the teaching-learning process.

Criterion 5.b.: Results of evaluation guided subsequent instruction.

Teacher uses results of evaluation in the construction of future objectives and in the modification of teaching strategies.

Criterion 5.c.: Learners were encouraged to engage in self-evaluation.

Students are involved in a process whereby they evaluate their own work, effort, and progress.

The Category of Teaching Competence Related to the Purpose of Teaching

COMPETENCY SIX: Learners Make Educational Progress

This category deals with the critical matter of student progress. The entire instructional process is aimed toward this tangent. The lessons taught may be fun and appear to

be appropriate. But, if there is no indication of student progress, then there is cause for concern. Ideally, all the above categories ought to relate directly to the educational progress of the learners. If all of the above categories were met, then learner progress should follow.

To a great extent, this category is based on the objectives of the unit of instruction. Does the evidence indicate that the objectives were accomplished and that the growth of the learners is what could be expected, given this class, this material and these circumstances?

Criterion 6.a.: Learners showed increased knowledge and comprehension.

This criterion deals with pupil growth in the lowest levels of learning, that of learning basic information or skills. This category would deal with shared items such as recall of events, dates, facts, operations, processes, etc. The basic question to be asked is "Did the pupils meet the knowledge level objectives that were established by the teacher?" Given the time, materials and circumstances, are the pupil gains approximately what could be expected?

Criterion 6.b.: Learners showed increased ability to apply knowledge.

This criterion deals with learner gains which go beyond the acquisition of knowledge. At this level, the focus should be on "those objectives which call for the application of knowledge." Once again, the objectives stated by the teacher should be reviewed. Were those objectives that called for the application of knowledge met? Given the time, material, and circumstances, are the pupil gains in applying knowledge approximately what could be expected?

Criterion 6.c.: Learners showed desired changes in attitudes and appreciations.

The teacher obtains information that indicates that students have or have not made the intended changes (or maintained desirable behavior) regarding attitudes and/or appreciations.

Criterion 6.d.: Learners showed increased psychomotor skills.

This criterion may be obvious for such classes as physical education or industrial arts. However, assisting youngsters improve their dexterity in manipulating equipment and their own bodies is an appropriate objective for most classes.

Criterion 6.e.: Learners were aware of their own accomplishments.

To provide learning reinforcement, it is essential that each student knows and can articulate his or her gains in learning.

The Categories of Teaching Competence Related to the Role of the Teacher

COMPETENCY SEVEN: Maintains Positive Relations with Professionals

Too often students of teaching mistake lack of sensitivity for candor. In an effort to be open and candid, they make negative remarks or imply negative opinions about the teaching of others. Such behavior usually reflects arrogance and an insensitivity to others. Teachers must develop a tolerance for different teaching styles, strategies and values in order to permit career-long professional growth.

As to assessing student teacher performance in this area, it would seem best to use the "no evidence to the contrary" procedure. That is, periodically, the supervisor (or cooperating teacher) asks the question: "Do I have any evidence to indicate that this student teacher is not maintaining positive relations with professionals?" If the answer is no, then the student teacher is rated with a (+) or yes on the appropriate form for that period. If there is evidence of negative relations, a (-) or no rating is marked for that period, and of course, the evidence and its implications are discussed with the student teacher.

Criterion 7.a.: Discussed issues tactfully.

The teacher, when working with other professionals, behaved in a manner that reflected sensitivity to the feelings and ideas of others. Examples of tactful vs. tactless behavior would include the following and might occur in faculty meetings, conferences, parent contacts, the teachers' lounge.

Criterion 7.b.: Worked productively with others.

Frequently, students have preconceived notions how to work with youngsters and reject the ideas of other teachers. The practicum is short, and the student is the guest of another. It is essential to maximize the learning potential of the experience by being open to and contributing to the school's staff and program.

Criterion 7.c.: Kept privileged information confidential.

The teacher does not divulge privileged information gained from students or parents, whether gained informally or in private conference.

COMPETENCY EIGHT: Maintains Positive Relations with Learners and Parents.

The teacher seeks to build upon the strengths of both learners and parents in the manner in which he or she talks to them, in the attitude of acceptance of each child and parent as a capable person and in the way in which he or she plans for successful experiences and responses. Each learner is respected for his or her own unique responses and characteristics. The teacher avoids comparisons and labeling phrases, both when counseling learners and conferencing with parents.

Criterion 8.a.: Developed and supported the learners' sense of self-worth.

The teacher accepts learners' contributions and gives positive reactions to them.

Criterion 8.b.: Accepted learners, regardless of ability or background.

The teacher plans activities in which the learners can achieve success at different levels. The teacher also plans experiences which recognize that the learners come from varying economic, cultural and racial backgrounds and imply that he or she values the heritage of all children.

Criterion 8.c.: Maintained the confidence of parents.

The teacher maintains confidence of parents through communications with them. This is done through attending PTA meetings and Open House, as well as parent-teacher conferences or sending notes home. In conference, the teacher should avoid educational jargon and be specific, using examples to illustrate comments. Be mindful that, to a large extent, parents form their perceptions of teachers from what their youngsters say.

COMPETENCY NINE: Exhibits Commitment to the Profession of Teaching.

Perhaps this is the most difficult area to assess, and yet in many ways it is the most important. In a time when the society has the luxury of selecting the best teachers from among many who are available, this element may be a very influential factor in hiring decisions. Principals and parents are both looking for the kind of person who will continue to grow professionally through an entire career. Capacity for self-examination and determination to change, adopt new techniques, and respond to suggestions for improvement are indicators of this vital component of teaching.

Criterion 9.a.: Responded positively to suggestions for professional improvement.

The teacher shows genuine appreciation for suggestions made by field supervisor or clinical professor by thanking them for offering the suggestion, asking them for specific help in implementing that suggestion in his teaching behavior and actually following through, making the suggested change.

Criterion 9.b.: Sought suggestions for professional improvement.

The student of teaching provides supervisors with self-evaluations of teaching performances in the classroom and related performances in other school activities and requests specific assistance following each major endeavor. Comments or suggestions may be solicited from pupils.

Criterion 9.c.: Contributed to development of improved programs.

With the advice and support of supervisors, a student of teaching may take special efforts to enrich or revise an existing unit or part of an instructional program. Alternatively, this can related to the student's efforts to improve his or her own technical skills of teaching.

Criterion 9.d.: Accepted responsibilities of the professional teacher.

There is more to teaching than interacting with youngsters or diseminating information about a favorite subject. Some of the responsibilities, such as planning for instruction, evaluating the results, supervising youngsters and committee work, are often not as enjoyable as teaching. But, in fact, they are as much a part of teaching as talking with youngsters. Failure to attend to some of these parts of the role of teaching indicates a serious weakness in the commitment to teaching.

Criterion 9.e.: Modified teaching behavior on basis of self-evaluation.

There are several sources of feedback regarding the process of teaching — supervisors, pupils, other students and teachers. However, all of these factors must be filtered through the student's own perception of events. Therefore, it is essential for students of teaching, to strive to attain a degree of detachment from their own teaching in order to be as objective as possible in assessing it themselves.

SUMMARY

As has been indicated in this presentation, the student teacher supervisor exerts much influence on the student of teaching and, in turn, on the learners. His role in the

pre-service preparation of the teacher is a complex one that demands that he be an administrator, counselor and educator, with more and more responsibility being placed upon him to aid in selecting competent teachers for the public schools. No longer is a visit to the classroom or laboratory to see the student of teaching adequate. He must be completely familiar with the subject area as well as with the process of determining what constitutes a competent teacher.

No longer is there a great teacher shortage, as was witnessed 10 or 15 years ago when anyone who completed a teacher preparation degree, regardless of his ability to perform in the classroom, could get a teaching position. Society is demanding that the teachers of today be able to demonstrate many competencies other than knowledge of the subject matter. The basic competencies have been outlined in this presentation. It then becomes the responsibility of the supervisor, as well as the cooperating teacher, to assess the competence of the student of teaching to determine his level of competence as a teacher, based on thé established criteria. A great responsibility is now being placed on the supervisor to assist in the selection of competent teachers for the schools of the nation.

Material for this presentation has been extracted from the Handbook for Students of Teaching, Western Washington State College, Bellingham, Wash., by permission of Dr. Leonard Savitch, Director of the Office of Field Services.

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Teaching N/C: Basic Concepts and Instructional Procedures

Douglas Pine

This presentation has been developed to meet two primary objectives.

1. Provide the audience with some realistic instructional alternatives for giving students learning experiences related to numerically controlled machining processes.
2. Provide the AIAA Research Committee with a progress report on the development of an instructional package for teaching N/C concepts.

Much of the material to be previewed today has been drawn from the writer's dissertation (Pine, 1974). The writer was contacted by the Research Committee with the notion that perhaps the existing instructional package developed during his research on numerical control could be adapted for dissemination through AIAA. This proposal was accepted by the writer and thus, the progress report today.

THE PROBLEM

Automation is such a major historical phenomenon that many have considered its inception to be the start of the Second Industrial Revolution. Regardless of what label historians finally apply to this phenomenon, "It is clear that a dynamic force of great potential has broken loose, and that we will suffer greatly if we do not study its implications and try to deal intelligently with some of them (Evans & Arnstein, 1962, p. 2)." The technological and societal changes which have occurred as a result of the advent of automated and cybernated manufacturing and service operations are astounding. Some implications for industrial arts education with regard to automation and technological change can be gleaned from Wriston's (1962) statement.

> For almost a century, since the passage of the Morrill Act, too much emphasis has been placed on narrow vocational training. There is need for reform in this area; tremendous stress must be laid upon principles rather than techniques. Mere procedures increasingly become obsolete before they can be taught, much less applied. Education should aim for the development of flexibility to help people shift from one form of work to another when necessary (p. 172)...

Industrial arts has for mahy years professed to be a part of general education where students study the industrial and technological nature of our society. Few industrial arts educators would reject the notion that students should have a general understanding of automation and experiences which expose them to some of the basic automated manufacturing processes. However, research studies by Hoover (1967) and Baker (1971) clearly indicate that industrial arts teacher education institutions are not providing instruction that reflects modern manufacturing processes to the extent that they should. As an example, Baker's study found that 96.4 percent of the industrial arts teacher educators surveyed agreed with industrial personnel that automation and cybernetics should be included as a major component of the curriculum. However, only 61.9 percent of the same institutions offered studies of automation as significant part of their program.

Baker also surveyed the relative value of 28 automated systems to manufacturing industries. One of the most highly valued systems was numerically controlled (N/C) equipment which 85 percent of the industrialists rated as "very valuable," 15 percent as "of some value" and zero percent as "not of value." (p. 85) These ratings were second only to those received for digital computers. The industrial arts teacher educators rated N/C machining 65 percent, 35 percent and zero percent, respectively. Further support is added to the importance of the N/C machining concept through Hoover's study which indicates that 100 percent of the production executives surveyed felt that the future use of N/C equipment would increase.

Hoover's research uncovered another significant finding which generates another concern. Of those industrial arts teacher educators surveyed who taught numerical control concepts, 74.8 percent relied on the lecture method as the predominant means of conveying those concepts.

The foregoing findings evoke the following questions:

1. What type of instructional methods should be employed to teach the basic concepts of numerical control machining effectively and efficiently?
2. What type of hands-on activities could be developed that would provide the student with experiences in applying N/C concepts?

SOME INSTRUCTIONAL CONSIDERATIONS

A review of the instructional materials that are currently available to teach about automation, and particularly N/C machine tools, revealed a proliferation of various media. The possibilities for providing educational activities related to numerical control are not as numerous. Csont (1966) notes the excessivey high expenses involved in equipping a laboratory with N/C equipment. Numerically controlled machines will range from $10,000 to $100,000 and more. Westling's article (1966), "Teaching to Understand the Fundamentals of Numerical Control," suggests that N/C principles can be taught without having a numerical control system in the laboratory. Instructional materials can be used to teach the basic concepts. However, the instructional materials as proposed by Westling do not provide hands-on activities.

If the cost of N/C equipment is excessive, what kind of hands-on activity can be provided that will still include the basic operational concepts? The results of Crowder's (1968) doctoral thesis showed increased learning and retention of selected general shop units when the use of instructional models was compared with conventional methods.

Taylor and Christensen (1967) provide further direction to the idea of employing models of systems for purposes of instruction.

> It is an audio-visual maxim that media can be utilized to bring to the learner experiences that are beyond the resources of the local school system and not directly accessible to the classroom (p. 18)....
>
> Experience in the space program provides convincing evidence of the value of simulation as a means of giving the student pre-employment experience through procedures less expensive or hazardous than the actual operations. Media could be employed to give the student simulated experiences on highly expensive machines or machines currently used in industries but not available to schools because of cost, space, or other factors. Simulation would presumably reduce the amount of time that individual students would need to spend on drill and practice on the actual machine (p. 19).

The foregoing notions suggest that simulation systems may:

1. Stimulate interest in the subject area.
2. Provide for tangible and practical applications of the concepts being studied.
3. Reinforce and advance the student's understanding of the concepts.
4. Provide realistic experiences in the performance of the operation under study, and
5. Achieve economies in the teaching-learning process.

The instructional sequences in the study of numerical control as developed in dissertations by Biekert (1971), Rummell (1972) and Umstattd (1970) and in textbooks by Howe (1969) and Roberts and Prentice (1968) all follow a basic three-phase format.

1. The student studies basic N/C concepts such as dimensioning systems, tape coding systems and the basic elements of numerical control.
2. The student studies numerical control programming techniques and learns to write N/C programs.
3. The student machines parts or products following the N/C programs he has written, thus affording him an opportunity to validate the program and to make practical applications of N/C concepts.

If commercial numerically controlled machine tools cannot be utilized for instructional purposes due to the prohibitive cost factor, what alternatives are open to the industrial arts teacher interested in teaching an instructional sequence as outlined above? Any one of a number of different approaches could be employed in teaching a unit on numerical control. The literature provides a proliferation of support for the multi-media approach as an effective method of eliciting both student learning and interest. The study of basic N/C concepts (phase one) and N/C programming (phase two) can readily be taught via a multi-media format. However, producing parts or products (phase three) obviously requires the availability of a numerical control machine tool system. The idea of simulating the N/C machine tool operation as a hands-on activity seems to bridge the gap between a strictly multi-media approach with no activity and an instructional approach with the use of N/C equipment.

THE N/C UNIT

After determining what to teach about numerical control, specific behavioral objectives were developed for the unit.

As a result of their learning experiences, the students should be able to do the following at the conclusion of the instructional unit:

1. Distinguish the key phrases in the definition of numerical control from non-definition phrases.
2. Identify the basic steps to be followed in producing parts by N/C.
3. Match N/C personnel job descriptions with the appropriate N/C job title.
4. Recognize the key distinguishing features between an open-loop and a closed-loop servo-system.
5. Identify the major advantages and disadvantages of N/C.
6. Identify the types of input media employed by N/C systems.
7. Recognize the meaning of EIA.
8. Exhibit an understanding of the basic nomenclature associated with the EIA tape coding system.
9. Demonstrate an understanding of the EIA tape coding format by solving tape decoding problems.
10. Demonstrate an understanding of the cartesian coordinate system by solving coordinate location problems.
11. Identify the major features of the absolute dimensioning system.
12. Identify the major features of the incremental dimensioning system.
13. Exhibit an understanding of the basic nomenclature used in N/C program writing.
14. Identify the distinguishing features of the word address programming format.
15. Exhibit an understanding of the word address programming format by decoding a block of information.
16. Identify selected preparatory functions used in N/C.
17. Identify selected miscellaneous functions used in N/C program writing.
18. Demonstr[illegible] proficiency in N/C program writing by solving selected programming pro[illegible]ms using the work address format and the incremental dimensioning system.

The foregoing literature review identified primary topics to be treated in a unit on numerical control. The behavioral objectives can also be grouped around these primary topics as follows:

1. Introduction to N/C
2. Basis for N/C Dimensioning
3. N/C Part Programming
4. N/C Tape Coding System

After careful examination of each topic for appropriate content and student activity possibilities, the following lesson sequence was established:

Day 1. Introduction to N/C
Day 2. N/C Dimensioning Systems
Day 3. Programming Formats
Day 4. Group Programming Problem
Day 5. Programming Problem No. 1
Day 6. Program Validation
Day 7. Tape Coding System; Programming Problem No. 2
Day 8. Program Validation
Day 9. Advantages and Disadvantages of N/C Program Validation
Day 10. Unit Examination

The two-week unit of study was developed to provide the teacher with a complete package of instructional materials. Lesson plans are included for each presentation. Each presentation is followed by some type of student activity. Transparency masters are included along with student handout and laboratory activity worksheet masters. The unit examination includes objective-type questions plus a programming proficiency section.

A prospective user of this instructional package should be aware of the one major decision required for effective implementation of this program. What will be the method of program validation? Such a decision will most likely require that some sub-questions be answered first.

There are several methods or alternatives to be considered as one procedes through the decision matrix. Although student motivation is an essential factor, the decision will most likely be governed by budgetary considerations. Some of the alternatives include:

1. Check against answer key
2. Product a part using:
   - A. Production Type N/C Machine
     - New
     - Retrofit
   - B. N/C Training Unit
   - C. Simulation
     - Conventional Mill
     - Positioning Table
     - Instructor Fabricated Simulator

The first alternative should receive a low rating, if not an unsatisfactory rating, for student motivation. Methods 2A and 2B would seem to be desirable in that they both provide experiences with tape controlled units or the "real thing." However, even the N/C trainer requires a budget of $3,000 plus. Alternative 2A will be closer to five times that amount.

Perhaps simulation will provide a viable alternative. A case has already been made in the foregoing literature review for the advantages of simulation. Conventional mills and positioning tables will get the job down, but perhaps with a lack of realism since everything is done manually. The use of an instructor-fabricated power-driven simulation may alleviate the realism and budget problems without appreciable loss in student motivation. The research of Pine (1974) and Umstattd (1970) included the development of two such simulators at a material cost of $300 or less.

SUMMARY

Realizing the far-reaching effects of automation on our daily lives, educators have been vigorously exploring strategies to prepare students to live in and to understand our industrial-technological society. This preparation should include a realistic study of automation and N/C. Activity-oriented industrial arts has a special contribution to make

toward the element of industrial literacy through the concrete, hands-on opportunities it provides in making education meaningful and relevant.

Several research studies have highlighted the development of numerical control as representing the most powerful advancement in metalworking technology of this century. The concept of simulated numerical control has been explored by Umstattd (1970), Rummell (1972), and Pine (1974).

The availability of N/C software does not appear to be a major problem in initiating N/C curricula. However, the prohibitive price of N/C hardware has been cited as the primary obstacle to introducing a hands-on approach to studying numerical control. Several industrial educators have reported the need for a low-cost N/C instructional package that would offer the hands-on capability. The idea of utilizing a numerica control simulator as an integral part of a multi-media instructional package has been gleaned from the literature as offering a promising alternative to this perplexing problem. The instructional package being developed by the writer for possible dissemination through the AIAA is one effort to meet these apparent needs.

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Student Teaching Supervisor's Role in Guiding, Stimulating and Promoting Good Public Relations

G. N. Rau

The student te ching experience for a particular young man or lady would be very similar to the basketball coach's big game on Friday or Saturday night. Throughout the week the coach has drilled his team with regard to basic basketball fundamentals and principles; furthermore, he has revealed and practiced quite intensely a game plan which he feels will work against his Friday night opponent. In reserve, however, he has indicated the possibility of adjusting or modifying this game plan if the existing circumstances should so dictate during this important contest.

It has been my experience over the past five years that the student teaching experience is a very climactic segment in an individual's baccalaureate degree program, similar to the big weekend game. Thus, if the student teacher has been properly groomed throughout his previous three years of undergraduate work, he should be adequately prepared for that big weekend contest. To provide the opportunity for a fruitful student teaching experience, the supervisor has the following responsibilities:

1. To provide encouragement with emphasis on guidance
2. To perform q catalytic, stimulating and supportive function
3. To act as a vehicle or mechanism to promote good public relations among the university, the industrial education department, the workstation, the cooperating teacher and the workstation school

A look at the three components of the supervisor's role is most imperative. What are the entities which encompass the guidance facet? In a recent Phi Delta Kappan issue, an article fo using on teacher education stated, "The p e to learn to be a teacher is in a school." (Spillane & Levenson, 1976) Furtherm , this article stated, "The skills needed by prospective teachers are essentially those dealing with people: students, parents, community people, fellow staff members." What then are some essential activities which would provide teacher aspirants with these skills?

A student teacher needs to be guided and encouraged to:

1. Participate in departmental meetings led by a department chairperson.
2. Participate in a school faculty meeting called by the school principal.
3. Share some time with the school principal regarding the school's philosophy and problems such as vandalism, truancy, and those typical to school restrooms.
4. Share some time with the school counselor as to how and what students are counseled into industrial arts and vocational education programs.
5. Share some dialogue with members of disciplines other than industrial education.
6. Meet with members of custodial staff and discuss their duties and responsibilities.
7. Attend a PTA meeting.
8. Attend a school board meeting.
9. Become involved in extra-curricular activities.

The second role of the supervisor, as previously mentioned, is threefold. He performs a catalytic, stimulating and supportive function, particularly with regard to:

1. establishing an on-going teaching/learning environment.
2. attempting to implement other teaching methodologies.
3. working with students on an individual basis.

A third role of the supervisor is to promote good public relations among the university, the industrial education department, the workstation, the cooperating teacher and the workstation school. This may be accomplished through the following activities:

1. Establishing a seminar involving cooperating teachers to identify meaningful activities for intern teachers, from a qualitative as well as quantitative standpoint.
2. Scheduling a seminar for student teachers while they are student teaching to identify some

professionally rewarding experiences, providing constructive criticism, and discussing problems common to all student teachers.

3. Meeting with the school's principal and discussing the over-all progress of the student teacher.

In summary, these perceived responsibilities are basically part of the supervisor's job when working with a student teacher during his/her professional semester. By means of a concentrated effort on the part of the supervisor to fulfill these roles, each student teacher will become involved in some meaningful experiences which hopefully are professionally rewarding. Since the cooperating teacher works directly with the student teacher, I feel the major thrust of constructive criticism should be provided from the cooperating teacher at the appropriate time in the classroom or laboratory setting.

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A Tentative Taxonomy of Psychomotor Skilled Tasks

John M. Shemick

In writing his book on preparing objectives for instruction, Mager (1962) quietly started a chain reaction which has caused repercussions that are still echoing in all quarters of education. But, as straightforward as Mager was in his exposition, students have always had some difficulty in differentiating between observable behavior as an indicator and physical performance as the intent of an objective. Performance can range on a continuum from highly cognitive to a completely neuromuscular activity. Accordingly, there is a need for a breakdown of what is meant by performance in relation to tasks and the skills required for their successful completion.

With the development of the taxonomies of the cognitive domain (Bloom, 1965), affective domain (Krathwahl, 1964) and psychomotor domain (Simpson, 1966), educators have now a technical vocabulary that has proved to be of immense value in focusing professional communications. We are yet to have such a focused vocabulary with regard to skills, for readers are plagued with a plethora of ostensibly similar terms describing skills.

While some writers may use various skill terms interchangeably, others have recognized graduations and distinctions between them. For example, one can find in the literature such adjectives for skill as motor, sensorimotor, neuromuscular, manipulative, manual and perceptual, to name a few. Are these terms, in reality, different? Do they, in fact, describe different behaviors? Despite a lack of consensus, there are a number of writers who believe that they are different. Nonetheless, some practitioners may dismiss any concern for terminology as "sheer semantic nonsense." Yet there is a recognized need, for almost every writer dealing with skills learning has proffered some classification scheme ranging from nominal categories to a taxonomy. Further, Travers (1972) points out the need for a technical language in his discussion, "The Limitations of Variables Derived from Common Language." He feels that Bridgeman's position, in the thirties, that terms should be defined operationally has led to disastrous results. Finally, terminology seems especially important for researchers in industrial education when one considers the Whorf-Saphir hypothesis which, in essence, states that unless a real world phenomenon has been labeled and given verbal or abstract symbolism, the phenomenon is non-existent or invisible to the beholder (Harries, 1971).

Researchers interested in reviewing the literature on psychomotor learning are invariably led to either motor skills learning as it relates to physical education or that

subdivision of experimental psychology which Bilodeau (1966) characterizes as a field interested in studying motor skills in terms of making responses rather than selecting responses on cue. Neither of these sources are completely satisfactory in providing applications to industrial-type skills learning.

At the outset, some distinction should be made between ability and skill. According to Fleishman (Glaser, 1962),

> A psychomotor ability is a general trait of the individual which is related to performance of a wide variety of skills.... These abilities change very little in the adult. At any given stage, they are analogous to a wiring diagram that the individual brings with him to a specific task. This wiring diagram describes his psychomotor entering behavior. The distinction between ability and skill is fairly clear: A skill is performance of a specific task. For example, operating a turret lathe is a skill which depends on the basic psychomotor abilities of manual dexterity and motor coordination. These same abilities, however, are needed in other skills.

When one reviews the literature on psychomotor skills, he will notice that there are a number of paradigms presented which are predicated upon some single factor. For example, Seymour (1966) sees psychomotor performance in terms of work stations on the production line of a factory. Cratty (1973) bases his "topology" on the degree of complexity of movement, as does Merrill (1971). In contrast, Gagne's (1965) cumulative learning model parallels typical child growth and development stages. From Gagne's model Mager (1968) generated his five types of performance. Harrow (1972) is the only serious attempt at developing a taxonomy of the psychomotor domain since Simpson's (1966) work, but is strongly oriented toward physiological stages of development. Fleishman (1970), in his work for the armed forces, developed a binary decision-making model designed for task analyses necessary in determining abilities used in personnel selection programs. Also working for the armed forces, Miller (1969), in a more focused study, developed a restricted taxonomy of psychomotor tasks. However, in the final analysis, the most useful framework has been suggested by Posner (Posner and Fitts, 1969), who was strongly influenced by his mentor, Paul Fitts, and his "human performance theory."

The relationship between performance and skills is that if skill is the sequence of responses required of a specific task, then performance is the configuration of tasks. In the words of Fitts and Posner, performance is "an organized sequences of activities (p. 1)."

In their book, Human Performance, Fitts and Posner first break down performance into intellectual and physical skills. The physical (psychomotor) skills category is subdivided into language and perceptual-motor skills. Gross bodily, manipulative, and perceptual skills constitute the subordinate categories under perceptual-motor skills.

Corollary to developing a skills hierarchy is the classification and differentiation of terminology. Fitts and Posner break down performance in terms of a dichotomy between intellectual and physical skills. While this is an interesting contrast, the concept of skills being purely physical is somewhat unrealistic, for seldom do skills occur bereft of all or any cognition. Accordingly, the term psychomotor, a more commonly used term, was placed between what are essentially the two terminals of the skills continuum and reflects a relative position somewhere between them. The label cognitive-motor appeared in the work of Cratty (1973) and seemed an appropriate generic term to describe this level. Although a seeming paradox, the terms are consistent with the psychologist's definition of skill. That is to say, skills not only involve manual activities, but also activities which require internal manipulation of symbols as in languages and thought.

The second level encompasses language and perceptual-motor skills (Fitts and Posner, 1969) which are aptly labeled with Cratty's term, viz., verbal-motor skills. Kibler et al. recognized this major classification and titled it "speech behaviors" (Kibler, Barker and Miles, 1967). Although it is not a particular interest to industrial educators, it does lead into the heart of this presentation through perceptual-motor skills.

Each writer's proposal possessed significant and unique features which warrant inclusion in an overall model of a skilled task hierarchy. Fitts and Posner break down psychomotor skills into specific categories of performance, i.e., gross bodily skills, manipulative skills, and perceptive skills. We take bodily movements, such as upright posture and locomotion, so much for granted that one often fails to realize that other movements are superimposed on these gross bodily processes. As Cratty (1973) points out, "... individuals confined to a desk and proportedly engaged in fine motor activities

(such as typing or handwriting) frequently complain of backaches and similar discomfort involving the larger truncal muscles." (p. 17)

Gross motor skills underlie fine motor skills with a basic and fundamental character, either in a dynamic or static sense. This is not to demean or downgrade gross motor skills, but rather to dramatize its position as the foundation upon which fine motor skills are superimposed.

A number of writers tend to deal with perceptual abilities and neuromuscular skills together (Cratty, 1973; Harrow, 1972; Fitts and Posner, 1967). However, Moore (1970) has proposed a meaningful model which identifies perception and skilled performances as input and output respectively. She states, "Perception is considered here as an act of extracting information from material under consideration, and the perceptual process relates to input and output." Therefore, perceptual abilities appear outside the psychomotor performance hierarchy, but feeding into it at all levels. As Forgus (1966) implies in the title of his book, Perception: The Basic Process in Cognitive Development, perception is key in cognitive as well as in psychomotor performance.

The category of fine motor skills is focused primarily on the small muscles used in the arms and hands. A major subdivision within this category is manipulative or mechanical skills. Its subordinate elements are taken from Miller's (1969) Task Taxonomy which he first broke down into reactive and developmental skills. Reactive skill is made up of adjustive skills (steering a bicycle or automobile) and selection from a set of responses (typing or sight reading in playing a piano). Developmental skills are made up of procedural skills (assembling a piece of equipment or tasks requiring discrete steps) and skilled performance or adaptive skills such as linoleum carving, which requires adaptive action in relation to visual and kinesthetic feedback.

The second major category under fine motor skills is complex integrative skills. It deals with multi-element coordination to varying degrees of complexity such as eye, ear, hand and foot coordination (playing a piano by ear) or eye, hand and toe coordination necessary for sewing machine operation.

The category of gross motor skills has been subsivided into its underlying dimensions which reflect neuro-muscular development. The use of the hands at this level is prehensile (grasping) rather than manipulative as in the subsequent fine motor skills. These stages of development are represented by torso movement, upper limb, lower limb, and finally upper and lower coordinated limb movement.

The first sub-category, integrative gross bodily skills, are the skills used typically in sports or game activities. The simplest of these is static or non-locomotor, characterized by holding (grasping) and/or balancing. Activities which characterize dynamic non-locomotor skills would be batting a baseball, driving a golf ball, or lifting weights. In contrast, externally paced locomotor skills are like playing a tennis game, ballroom dancing, or playing soccer. Examples of internally paced locomotor skills are: broad jumping, pole vaulting, or the playing of a game of golf.

As one reviews research-studies, wherein the researcher reports a one best instructional technique for psychomotor learning, it is not surprising to find that subsequent researchers using different tasks report conflicting results. Accordingly, this proposed psychomotor skills hierarchy may, hopefully, provide a meaningful frame of reference for developing performance objectives in curriculum work and/or serve as a working model for further skills differentiation study.

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Developing the Rationale and Program

Warner K. Smidt

Why do I want to be in the honors program? Why put in the extra effort when I can just take the required courses and be done with it? For every thing we do in life, there has to be a reason. Right? When considering admission to the honors program, a valid reason must exist for it. When you go before the college honors committee to present and defend your rationale and program, the committee will closely examine you and your rationale for wanting to be on the honors program. If you do not have good workable reasons for wanting your program, then maybe you should stay with the regular program of study. Therefore, developing a rationale (i.e., a valid rationale) is a very important first step.

One must search himself to find out what he wants to get out of his education at the university. If the standard course of study in your area (major) fulfills all your educational goals — fine; then forget the honors program even exists. But if the standard course of study does not fulfill your educational goals, then the honors program is for you. In other words, the general rationale for entering the honors program is to be able to design your course of study via the freedoms offered through the honors program and all disciplines within the university. Carrying that one step further, every human being is unique; thus everybody has unique educational goals. Everyone pursuing any education should be on the honors program in order to be able to design that unique course of study and maximize the best of all elements to achieve their goals.

All the special options available to the honors student enable one to design a course of study tailored to individual needs. By visiting with your honors advisor and numerous instructors with whom you plan to do your studies, you learn of the possible options. Then, the student can identify his or her long-range goals and how he or she is going to achieve those goals. In light of the results of these discussions, one can prepare a program that will be presented to the honors committee. The program will be written up and must include the following:

1. application page — includes grades earned by quarter to date.
2. title page
3. first page — rationale
4. course work
   a. courses already completed
   b. courses being taken presently
   c. courses to be taken under the honors program
   d. courses to be dropped from the regular program — explanation required
   e. courses t be added or altered — explanation required
   f. courses to be taken pass/not pass
5. honors project

An honors project is one of the requirements if accepted on the honors program. The idea behind the honors project is ACTION RESEARCH. The emphasis should be placed on useable results instead of just a written report. The honors project would enable a student to delve into an in-depth experience in an area of personal interest. As a result, hopefully, the student will have applied research as a useful tool for the future.

The Supervisory Role in a Field-Based Teacher Education Program

Earl E. Smith

Traditionally, the university student teacher supervisor has performed a number of varied activities in the accomplishment of his duties related to the supervision. Considerable similarity can be noted in the scope and content of procedures used by supervisors in the various institutions. Activities of the supervisor are typically planned to help the student teacher achieve the expected competencies with a maximum competence and minimum personal anxiety. The activities performed and experiences related to each are often similar to the ones summarized in the following items:

1. Pre-experience responsibilities.
   a. Establish contact with the school administrator and participating teachers.
   b. Plan, with the cooperating teachers, appropriate educational experiences for the student.
   c. Cooperatively, with the teachers, establish procedures for:
      (1) Timing of student's transition from class assistant to teacher responsible for instruction.
      (2) The process of achieving the transition.
      (3) Variety and pacing of experiences.
      (4) Formal, cooperative, and systematic evaluation of student's performance.
2. General responsibilities during the student teaching experience.
   a. Establish rapport with the student to develop a helping relationship.
   b. Orient the student to the professional and personal responsibilities of his assignment.
   c. Perform regular observations and evaluations with follow-up conferences with student and cooperating teacher(s).
   d. Plan and lead regular scheduled group seminars.
   e. Share professional knowledge and experience with student and cooperating teacher.
   f. Plan and lead regularly scheduled seminars.
3. Concluding activities.
   a. Do cooperative summary evaluation and grading of teaching activities and experiences.
   b. Evaluate and grade seminar activities.

c. Have a closing conference with each student, administrator, and cooperating teacher.
d. Prepare necessary reports and recommendations.

Adopting a field base program alters the emphasis upon many of the activities performed by the supervisor. The changes are primarily related to the level at which the students are ready to function as they enter the student teaching experience. To establish how these prior experiences are obtained, it will be helpful to describe how our field base is organized.

The School of Education at Oregon State University, in consortium with the public schools, operates a field base teacher education program. Students are professionally prepared through a series of three field experiences, accompanied by or in conjunction with campus based theory instruction. Additional courses in other professional subjects complete the student's preparation.

In the initial field experience, the student assists the teacher for three hours each day as a classroom aide. Emphasis is upon activities that involve the student with the learner as an individual in the environment of a public school. Stress is placed upon experiences related to foundational theory, the public school as an institution and a regular seminar.

Within the concept of a spiral curriculum, the second field experience places the individual into a daily interaction with students in the role of a teaching aide. Assisting the classroom teacher at a level less than that of a student teacher, the student teaches and performs supportive professional activities with small groups and individuals. This experience level is accompanied by on-campus studies in special methods, curriculum, media, evaluation, adolescent psychology, reading methods and a field experience related seminar.

The first two levels of field assignments provide the student with more than 250 hours of supervised classroom experience. This in-depth involvement prepares the student for the final stage of the spiral program, which is accomplished through the full-time student teaching assignment. The student teaches three classes and observes one as a part of a full-day school assignment. Earlier experiences provide the student with competencies to allow him to assume the instructional leadership role rapidly during his student teaching experience.

Supervision is emphasized as an important responsibility at all levels of the field base program. This emphasis, therefore, alters the nature of supervision needed during the student teaching assignment. As the student progresses in the field experience, supervisory expectations change with the differing responsibilities of the student. Supervisory roles are viewed in the following combinations of responsibilities:

1. Facilitator with involvement as a communicator, observer, resource person, evaluator and seminar instructor.
   a. Example of the role performed:
      (1) Serve as liaison between the classroom teacher and the university student.
      (2) Make available any help needed by the cooperating teacher.
      (3) Guide the university student's observations within the classroom.
      (4) Counsel the university student in relation to his personal concerns about teaching, to incidents which alter self-confidence, and to offer suggestions for further involvement and growth.
      (5) Help the student develop a professional attitude in discussions of teaching styles, individual students, and particular school philosophies.
2. Resource professor who functions as a leader, director, communicator, evaluator and seminar instructor.
   a. Example of the role performed:
      The role of the university supervisor is to serve in a helping capacity to the students, his responsibilities in the school and to the students in seminars. To include:
      (1) Making all assignments precise and in written form if appropriate.
      (2) Knowing the facilities and resources of the secondary school involved.
      (3) Informing students of staff member's free time and telephone numbers.
      (4) Taking an active part in the seminar.
      (5) Evaluating journals, resource files and any independent projects at mid-term and final periods of the term, including grades.
      (6) Sharing professional knowledge and teaching tips when appropriate, as well as keeping

informed of current educational trends.

(7) Communicating with cooperating teachers and observing university students in classroom.

3. Student teaching supervisor who performs responsibilities such as communicator, liaison, organizer, helper, evaluator and seminar instructor. Added details of these roles have been illustrated in the discussion of the traditional student teacher's responsibilities.

Based on the depth of experience obtained by the student in the field experiences at he first two levels and the continuous supervision, the supervisor of student teaching is ible to function more in a helping relationship. Many of the introductory activities have ilready been achieved by the student. He also has competence in classroom management, irganization and supervisory responsibilities. The student is able to move rapidly to idvanced activities within the school setting. His ability to perform within the expected irofessional responsibilities makes it possible to include experiences of a more advanced iature. The student often assumes early control of the class and maintains full responsibility for the classroom activities.

The university supervisor and the public school supervisor are able to better perform he supervisory functions as team members. Considerable emphasis is given to the role of the classroom teacher as a model and major source for direction and supervision.

The content and activities of the student teaching seminar have also become more idvanced than those typical of programs not using the field base experiences. Emphasis n seminar activities is upon developing a forum for discussion of issues and problems onfronting student teachers. Opportunities are provided to present, analyze and generate iolutions to current problems or projected classroom experiences. Students are ready or more complex assignments and make major gains in preparing for career entry.

Changing to a field base program offers an excellent opportunity for the student eacher supervisor to truly become a "helping" supervisor.

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A Competency-Based Teacher Education Program: Graphic Arts

Kenneth T. Smith

During the early 1970's, educational environments were requested to specify programs lealing with teacher education in terms of student outcomes. In some states mandates vere placed upon institutions of higher education through recommendations of Boards of Regents for legislative action.

In New York State the Regents emphasized the establishment of a system of Competency-Based Teacher Education and Certification, "a system by which the state can assure the public that professional personnel in the schools possess and maintain demonstrated competence to enable children to learn."

The confusion that exists with actualizing a curriculum employing a competency-based teacher education approach seems to involve 1) definitions of CBTE, 2) where does n institution begin, 3) how do you get started, 4) what are the ground rules, 5) what does he delivery system look like, 6) who will or should be involved, and 7) where do funds xist for institutional and department research, development, implementation and evaluation.

In defining CBTE, Houston and Howsam summarize their position in this way:

> Competency-based instruction is a simple, straightforward concept with the following central characteristics: (a) Specification of learner objectives in behavioral terms; (b) specification of the means for determining whether performance meets the indicated criterion levels; (c) provision for one or more modes of instruction pertinent to the objectives, through which the learning activities may take place; (d) public sharing of the objectives, criteria, means of assessment

and alternative activities; (e) assessment of the learning experience in terms of competency criteria; and (f) placement on the learner of the accountability for meeting the criteria.

Cooper and Weber def... CBTE programs as containing the following characteristics

> A competency-based teacher education program specifies the competencies to be demonstrated by the student, makes explicit the criteria to be applied in assessing the student's competencies and holds the student accountable for meeting those criteria. While at first glance this definition appears to depict a rather harsh, almost mechanistic process, nothing could be further from the truth. The competencies referred to are attitudes, understandings, skills and behaviors that facilitate intellectual, social, emotional and physical growth in children. The student is held responsible for demonstrating these competencies, because they are necessary to teaching effectiveness.

The New York State Education Department perceives CBTE as:

> ...a system which requires that preparatory programs for school personnel explicitly state objectives and standards that must be met by candidates for certification. The state's definition of competence-based teacher education further assumes that teachers-in-training will engage in a flexible instructional program so designed as to allow them to acquire and refine the skills, knowledge and attitudes necessary to meet the specified criteria for program completion and for certification. The term competence-based teacher education implies that assessment procedures are intimately related to instruction and to learning experiences and that these procedures incorporate and explicate required conditions of performance and levels of mastery.

The commonalities of most definitions reviewed concerning competency-based teacher education included the following characteristics:

1. Performance/behavioral base
2. Criterion-referenced evaluation
3. Emphasis on individualizing instruction
4. Multiple option opportunities
5. Mediated strategies implemented
6. Written specifications of the curriculum for public awareness
7. Student accountability of criteria

With the above ground rules, educational systems have the opportunity to assess their present curriculum to validate whether or not CBTE is in operation in some or all of the present course offerings.

Where would be an effective starting point for an on-going program in industrial arts teacher education? One strategy offered would be for a department or unit to consider their curriculum rationale using existing models such as Tyler's Curriculum Rationale or Hauenstein's Process and Products. The program goals could be produced after processing a needs assessment of the community school and individuals.

An assessment of current curriculum should be and has been an on-going process to determine efficiency, effectiveness and relevancy of skills, knowledge and attitudes students gain from preservice professional and technical experiences in industrial arts teacher education. If change was non-existent, or minimal application occurred, a department must explore strategies for developing desired change. Targets for the change process are:

(1) The attitudes, values and behavior systems of all personnel who will be involved.
(2) The organizational and communications structures centering around the programmatic base.
(3) The reward system employable to motivate the people who need to be involved.
(4) The curricula studied by students.

Each institution must begin at the point that takes the above into account and can most effectively make change with the least psychological turmoil among the participants.

One way for a department to get started is to employ some pilot courses to implement various strategies centered around CBTE. Using the latest research findings and observing model programs around the nation, certain avenues could be employed and validated. It is suggested that those courses selected for implementation and evaluation

use different strategies in order to determine one or more effective procedures for future programs.

Whole programmatic changes must occur but first essential development of certain courses can assist in alleviating some of the psychological impact that occurs with change.

The ground rules should be specified by the majority of participants within any educational environment. Maximum participation gives CBTE a greater chance for success and assists in developing a supermarket of employable strategies. The delivery systems may vary to some extent, but all should contain the seven characteristics of CBTE as discussed earlier.

One suggested delivery system is Hauenstein's Module Model located in the American Industrial Arts Association's 35th Annual Convention Proceedings. This clearly states an employable system that might be adapted for use in any institution of higher education.

Hauenstein defines his system components as:

Course: A universe of major function of human industrial activity.
Module: One of the major functions or steps in a process leading to goal achievement.
Task(s): Statements of activity or performances that exhibit the level of competency expected under given conditions.
Enablers: Criterion-references statements of activity.

One adaptation that might occur with the above definitions would be to define a course as a universe of major function of human activity, which then would include the professional sequence.

Other delivery systems could be obtained from those institutions that have been involved in CBTE programs and are involved in the Multi-State Consortium on Performance-Based Teacher Education or the American Association of Colleges for Teacher Education in Washington, D.C.

A major concern of many institutions stems from the financial considerations of developing, implementing, assessing and redesigning traditional programs toward CBTE. All too often legislative mandates are initiated without adequate financial support for doing the necessary tasks required of departmental faculty, administration and consultation personnel.

With financial cutbacks in educational institutions across the country being a common denominator, progression towards a CBTE curriculum will mean seeking different avenues in order to release personnel to get the tasks accomplished. Differentiated staffing might alleviate some of the time/manpower concerns for a few, but a look toward external funding is vital to performing an adequate job.

State departments of education must have as a high priority the need to assess and redesign teacher education programs toward a performance-based approach. With a high priority in curriculum development, adequate funding might be obtained.

In order to gain one perspective of changing from a traditional type of program in industrial arts teacher education toward a competency-based program, I will use the pilot program established in the Fall of 1975 in the basic graphic arts course at SUNY at Oswego.

During the previous year an informal assessment of needs was accomplished to determine the existing program goals for undergraduate students attending Oswego as industrial arts majors. It was a concern of the faculty that we should move the program in a transitional phase, declaring only part of the courses offered as those that would be in a pilot phase.

Using the existing program goals, the next step was to conceptualize the operational body of knowledge. The outcome of this task gave the staff those universal elements around which we organized the content into the following instructional sequence:

Module 1. Conceptualizing Graphic Arts
Module 2. Defining the Message
Module 3. Defining Graphic Processes
Module 4. Generating Images
Module 5. Assembling Images
Module 6. Photo Converting
Module 7. Preparing Image Carriers
Module 8. Transferring Images

Module 9. Finishing a Product
Module 10. Producing Printed Products
Module 11. Evaluating IA Lab 160

After inserting a variety of cognitive and psychomotor activities, we ended up with a course handbook containing the above modules, a variety of tasks and numerous enablers. An example of a portion of a module follows:

MODULE 4 — GENERATING IMAGES

Introduction

Every printed piece has a primary function — to communicate. This function can be influenced greatly by how the message is presented. Just as we are concerned with the first impression we make on others, the impression of a printed piece is an important factor in how effectively it communicates the desired message. Printing involves more than just putting ink on paper. Printing involves a combination of interesting and attractive images that convey a message.

Goal 4.1

The goal of Module 4 is to conceptualize the image generation process into a system of symbols which are the means by which ideas are translated into visual images. The arrangement of these symbols and interactions of design elements are important to creating an effective visual communicative entity.

Task 4.1.1

Using three references such as textbooks, technical journals, manuals and practical examples, describe how the principles of design, i.e., balance, contrast, rhythm, proportion and unity, contribute to visually effective artwork.

Enablers

4.1.1.1 Read Chapter 2, "Graphic Communications." R. J. Broekhuizen
4.1.1.2 Read Chapter 4, "Photo Offset Fundamentals." J. E. Cogoli
4.1.1.3 Read Units 5,6,7,8,10,11,17 and 19, "Printing Layout: Design." Delmar
4.1.1.4 Read Chapter 4, "Design Through Discovery." M.E. Bevlin
4.1.1.5 Select additional reference material as needed to further expand your understanding of design principles and list the source and author
4.1.1.6 On a maximum of three pages, list and illustrate the principles of design in a manner applicable to a magazine illustration for toothpaste or any other household item.

During the semester, inadequacies were pointed out by students who spent more time writing papers to fulfill stated tasks than manipulating tools, materials and processes. Three of the pilot classes reverted to the traditional course outline after Module 4 and three classes completed all the modules during the semester.

In Module 11, participants were required to evaluate the system, content, teaching strategies and laboratory environment. From analysis of the data collected, it was determined that drastic modification had to occur.

Students strongly suggested that "hands-on" activities concerning tools, materials and processes should occur more often and earlier in the semester. They felt that a major reduction in the paper work should occur and additional time should be placed in gaining a greater level of skill in operating equipment.

Some areas that students enjoyed about the CBTE program were:

1. Procedures for evaluation
2. Adequacy of feedback concerning their performance
3. Degree to which the course was self-paced
4. Making public (inwriting) those performances required and the criterion level

After a careful evaluation of the data collected, a major modification was accomplished by reverting back to some of the more traditional terminology and changing the activities required in each of the modules. A system of rotating students through activity areas was developed to handle the logistical considerations of available machinery and resources.

The new course handbook contains the following eight modules:

Module 1. Establishing a Frame of Reference
Module 2. Designing the Message — Relief
Module 3. Printing by Relief
Module 4. Designing the Message — Screen Process
Module 5. Printing by Screen Process
Module 6. Designing the Message — Offset
Module 7. Printing by Offset Lithography
Module 8. Evaluating IA Lab 160 — Graphic Arts

Students were divided into three groups going through the following sequence:
Group A. Modules 1,2,3 — 6,7 — 4,5 — 8
Group B. Modules 1,4,5 — 2,3 — 6,7 — 8
Group C. Modules 1,6,7 — 4,5 — 2,3 — 8

In each group there is greater flexibility in equipment availability and individual assistance, with students proceeding at a rate commensurate with their abilities.

An example of the new modules follows:

MODULE 7 Printing by Offset Lithography

Introduction

Planographic printing, better known as offset lithography, is one of the major processes used to produce products in the printing industry. In order to present the total processes that are involved in offset, this module is broken down into subordinate areas that include (1) Process Photography, (2) Stripping, (3) Platemaking, (4) Orientation to the Duplicator and (5) Preparing and Operating the Duplicator.

Goal 7.1—Photographing Camera Ready Copy

The goal of Module 7.1 is to assist you in gaining skills and knowledge in photographing line copy using the process camera.

Task 7.1.1

Using an approved mechanical layout, the Cameraman's Sensitivity Guide, Orthochromatic film and the necessary chemistry, you will photograph the copy and develop the negative to a solid step four using the process camera. (10 pts.)

Enablers

7.1.1.1 Read Unit 31, "Graphic Communications," Broekhuizen.
7.1.1.2 Instructor presentation, "Making a line negative."
7.1.1.3 Task Sheet 5.1.1, "Making a Line Negative."

Task 7.1.2

Using your negative shot to a solid step four, you will evaluate the results and describe in writing any deficiencies that exist and what action you will take to correct these (5 pts.)

After field testing the modification of the modules and evaluating the instruments located in Module 8, it is hoped that a systematic curriculum model will be determined and that a major emphasis for improvement can center around the defined body of knowledge and variations of activities.

Much of the work accomplished by the group at SUNY at Oswego was not funded in any way, and needed time came after regular commitments in teaching and various other professional responsibilities. Without adequate funding for such elements as secretarial time, supplies, in-service training and release time for faculty who are involved, the process of implementation and evaluation of CBTE programs is slow.

An assessment of our pilot program gave us positive feedback that others in the department can view. It also may assist in avoiding negative situations that occurred through lack of adequate planning or misinterpretation of what we postulated and what was actualized.

One element that emerged was increased student interest in serving a partnership in developing a more effective, efficient and relevant curriculum.

In summary, it is suggested that an adequate CBTE plan be established with as many faculty as possible involved. This plan should consider existing models for curriculum development and contain the characteristics of CBTE programs. Ground rules that are

spelled out and definitions of terms assist in communicating the department's strategies in implementing a Competency-Based Teacher Education Program.

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Innovative Curriculum in Construction Technology

Gary Weede and Wayne H. Zook

At Illinois State University we saw a need for a change in our rather traditional wood technology curriculum. In fact, we envisioned some of the need for change as external pressure as we scrutinized our own program.

We were stimulated to make change in light of the evolving career education concept. Our students in both the teaching and non-teaching curricula would be confronted with preparation in obsolete content areas leading to employability problems.

The need for change was further stimulated by the involvement of staff members in the Illinois Department of Adult, Vocational, Technical Education on-site evaluation of secondary occupational education programs.

Course sequencing in relationship to a program area has become a major concern in program evaluation by the state. In other words, a series of courses must be sequenced to lead to job entry-level employability upon completion of a program.

Even though our program is not subjected to the same evaluation as secondary schools, we knew that our existing program probably could not withstand such an external evaluation. Thus, the education of college graduates in central Illinois with competencies in cabinet and furniture construction was not adequate to insure their employability.

Our concern was equal for both the teaching and non-teaching graduates. The thrust on the secondary level was toward a construction-oriented curriculum with a de-emphasis of cabinetmaking and furniture construction. To insure employability for our teaching graduates, we saw the need for construction orientation. Our non-teaching graduates needed the construction orientation for employment in mid-management positions related to the construction industry.

Another factor that stimulated the evaluation of our woods curriculum and our quest for diversification was dwindling interest among students and trade organizations in a

traditional furniture-oriented curriculum. We needed to seek alternatives, and we had several factors to consider: (1) The program had to lead to student employability. (2) The program had to appeal to student interest. (3) It had to be flexible in regard to facility needs, and the instructional material costs had to be limited. (4) It had to provide easy entrance and exit from the program for students, with a minimum of prerequisites. (5) It had to provide the students with a diverse array of non-teaching occupational alternatives. The non-teaching-related occupations identified included:

A. Retail lumber dealership
   1. estimator
   2. service planner
   3. retail sales
   4. assistant management trainee
B. Wholesale construction product representative
C. Real-estate sales and brokerage related
D. Municipal building commissioner aid
E. Consumer knowledge

In addition, the introductory portion of the curriculum had to provide adequate preparation for on-site fabrication, which was expected to be a major part of the total program.

After identifying the deficiencies of our existing program, the next step was to seek external help from the construction industry. This was initiated by a presentation to the Normal-Bloomington chapter of the Illinois Home Builder Association. The interest stimulated by the presentation resulted in the establishment of a three-member advisory committee consisting of representation of retail lumber sales, major home builders and developers.

The input from this committee resulted in the establishment of the construction component of the program. In addition to the utilization of the existing introductory wood technology course and the departmental architectural course, three other courses were established. The course sequence appears as follows:

(1) 220 wood technology
(2) 221 construction technology
(3) 211 architectural drafting
(4) 320 masonry construction
(5) 321 carpentry construction

The students also have the option of an externship with varying amounts of credit to acquire additional experience. Typical externships can be with lumber retail companies and city inspection departments.

In addition to the construction-related courses, the non-teaching students are strongly advised to acquire a minor in business or business administration. The business background is essential for entry into a management-type position in the construction industry.

The 221 course became the focal point of our curriculum development. Nineteen rather explicit units evolved for the course. We feel that the strength of the course is in the laboratory activities, which will be explained later.

The 19 units of instruction in the course are as follows:

1. Construction careers
2. Building codes and permits
3. Standard materials
4. Blueprint reading
5. Locating the structure on site
6. Determining elevation
7. Floor system layout
8. Wall layout
9. Rafter layout
10. Stair layout
11. Door and window assemblies
12. Siding story pole layout
13. Building a structure
14. Concrete materials and standards
15. Concrete form construction
16. Placement and finish of concrete
17. Concrete and masonry blocks

18. Brick construction
19. Material estimation

The identification of the content was relatively easy. However, the problem was developing the appropriate laboratory activities which could be carried on in a very conventional laboratory and with a minimum of departmental expenditure and student expense. The laboratory activities were necessary to reinforce the cognitive aspects of the course and also develop some psychomotor skills.

With the thrust toward competency-based education, we wanted the level of student performance on the activities to be measurable. In addition, it was necessary for the activities to reflect the real world as much as possible and remain within our original constraints of budget and space.

The first unit of instruction is an orientation to construction — and specifically occupational opportunities and required training for job entry. This is presented in a rather conventional way through lectures, films and guest speakers. An attempt is made to have a person representative of realty sales, construction financing, lumber retailing, building inspection and construction management make a presentation to the class. Following a thorough presentation of the most fisible career opportunities, the students are required to select a construction-related occupation and make a complete analysis of the occupation. This analysis involves a written report, detailing the job responsibilities, employment opportunities and required preparation for job entry.

The second instructional unit involves types of building codes, including specifications and performance codes, the four recognized model codes and the "one and two family dwelling code" which is a composite of the four model codes. The instruction centers around the rationale for building codes and the procedure for acquiring a building permit. The students are provided a written information unit and a sample building code.

The students assume the role of a building commissioner and evaluate a set of plans submitted for a building permit. The drawing has several factors such as door size and wall construction which do not conform to the requirements of the sample code.

In the laboratory activity the students must determine if a building permit can be granted. If not, the student must identify the changes which must be made. The students are introduced to such concepts as deed restrictions, zoning and minimum structural requirements throughout the unit. On-site building inspection by city officials is also covered in substantial detail.

The third unit consists of a study of standard materials used in the construction industry. This study includes standard sheet materials, lumber, millwork, hardware and fasteners. The students are expected to be able to identify the materials, name the unit in which it is sold and know the grading system relating to quality.

The fourth unit, blueprint reading and specifications, is the first time working drawings are introduced to the student. The plan which the students work with is used throughout the remainder of the course. In the blueprinte reading unit the students learn what is included on the drawing. For the student laboratory activity, key questions have been developed relative to room sizes, slope of the roof, distance between windows and similar information, thus requiring the students to familiarize themselves with the plans.

The specifications for the building are also included in this section. The concept of specifications is presented as a legal contract between the contractor and the prospective owner. The specification sheet then becomes a key part of the last unit of the course concerned with estimating.

The fifth unit of instruction deals with the process of locating the structure on the site. The importance of proper location is stressed, and the city ordinances dealing with set-back are introduced. The technique for setting and using batterboards is demonstrated to the students.

The laboratory activity involves having the students work in small groups and set up batterboards for a group of houses for a model city block. The activity is designed to be conducted on a practice athletic field or similar area. A line marker or curb serves as the point from which the set-back is established.

The drawing from unit four is used for the activity. After the boards have been set and properly squared, each group of students moves to the next set of batterboards and checks the other group. A tolerance of one-half inch has been established as the acceptable variation in diagonal measurement.

The sixth activity deals with various techniques of determining building elevation.

For this activity information is presented on the use of the builder's level, spirit level and line level. The three alternative methods are presented so that a student can establish building elevation in the event a builder's level is not available or the size of the job does not warrant its use.

The students establish the elevation of the four corner stakes for the houses located on the site in the previous activity. At least two of the three methods are used, one serving as a check on the other.

Unit seven is concerned with floor system layout including the spacing of the floor joist on the outside foundation walls and the center girder.

The laboratory activity is designed to give the students experience in the location of floor joists. Students place four pieces of adding maching tape on a bench top. They then make a layout for joint spaced on 12 inch centers, 16 inch centers and 24 inch centers. Each layout is made in a different color of lead to facilitate correcting. This provides an experience for the students in making adjustments when the layout comes from both sides and meets in the center.

Since unit seven is the first student involvement with framing nomenclature, it is necessary to spend time presenting this information. The framing model becomes an invaluable aid for this purpose.

Unit eight deals with conventional wall layout. The drawing presented previously is used for all of the layout activities. The students make the layouts during the laboratory periods on adding machine tapes.

The students have adequate experience making the layouts so that when they enroll in the on-site course, layout is expedited and all students are able to work simultaneously. The lab activity allows all of the students to work independently.

The activities are graded by comparing them to a master tape prepared by the instructor. The tolerance of one-fourth inch error is accepted as the competency level. It has been found that secretarial help or students can do much of the correcting.

Unit nine involves rafter layout. The nomenclature associated with roof construction is presented to the students. The presentation is followed by a teacher demonstration.

The activity involves having the students make a layout for various kinds of rafters, using both the step-off method and the rafter square tables.

The activities and instruction starts with common rafters and progresses to hops, valleys and jacks. After the layout is made on the adding machine paper tapes, the students cut out the profile of the rafter. This makes it easy to correct by laying the student layout on a master copy. It also gives the student a better idea of the relationship of the angle of the cuts to the horizontal and vertical planes.

Unit 10 deals with stair layout, for which the technique is presented in the class. Written material is provided, including illustrations showing the procedure for making a layout. The actual layout is made on wide paper such as shelf paper, and the profile is cut out. The success of the students seems especially high when compared to the problems encountered by some experienced craftsmen. Stair layout has been found to be rather intriguing. In a typical laboratory activity the student is provided with the basic information on stair layout.

For the purpose of the problem, the student is provided with the total rise, total run and the thickness of the treads. The student makes the necessary calculations and completes the layout. The layout is cut out with scissors. It is then graded by laying it over the master copy. A tolerance of 3/16 inch between risers and treads is permitted from top to bottom.

Unit 11 consists of a study of door and window assemblies. Consideration is given to the standard sizes of door and window units which are available and the relationship between rough openings and header sizes.

Even though most contractors are using prehung doors, we feel it is essential that our students at least know the procedure for hanging a door. Thus our laboratory activity centers around the fabrication of a low clearance prehung door unit which would commonly be used in basement finishing and some remodel work.

The students cut the height of the hollow core door down, make jambs, hang the door complete with trim on both sides and install the lockset. The trim is just tacked on one sice of the unit so it can be removed easily and the door can be hung as a standard prehung unit.

The materials for this unit are provided from one of two sources. One source is anyone in the community who would like to have doors made up for a basement finishing

job. The other source is a local lumber company which provides us with doors regarded as rejects and seconds. From these materials we make up the door units and return them to the company as prehung units. The lumber dealer in turn sells them in his retail operation. Since our primary concern has been to provide the students with door hanging experiences, both sources have proven beneficial to our program.

Unit 12 deals with the layout of a story-pole for the application of horizontal siding. The methods of applying siding are discussed in class and then a laboratory activity is assigned. The students are given the distance measured vertically from the soffit to one inch below the foundation. They are also provided with different widths of siding and the maximum allowable exposure. They then make the spacing layout on a paper tape for each of the different widths of siding. The layout procedure is evaluated like the previous activities, allowing the students one-fourth inch of error in the layout.

Unit 13 is the capstone of the carpentry portion of the course. Here the students are able to apply what they have learned by building either a utility building or a model unit. Both units have definite advantages.

The building provides a good opportunity for installing a door and window assemblies as well as cutting rafters, shingling and many other common carpentry tasks.

The major disadvantage is that the building must be sold prior to beginning the construction.

The problem of obtaining a buyer does not exist with the model, and it also provides a good opportunity to reinforce nomenclature. Another major advantage of the model is that it provides intersecting interior walls and ceiling framing which does not exist with the utility building.

When the scale model is used as the alternative for fabrication, the plans which the students worked with in previous units are utilized. This allows for further familiarity with the same building.

Unit 14 is the beginning of the concrete and masonry construction units in the orientation course. In this unit a study is made of the contribution concrete makes to the construction industry. The overview includes foundations, footings, and slab designs.

The first student activity in concrete construction centers around mixing small quantities of concrete. These sample quantities are placed in paper roll tubes and allowed to cure. The samples are then tested for strength. Each day a sample is tested to demonstrate the relationship between cure time and conditions and ultimate concrete strength.

Different curing conditions are provided, such as air curing and water immersion curing.

To test the samples they are placed between two bench tops, and a bucket is attached with a piece of wire. The bucket is loaded with sand until the specimen fractures. The amount of sand is weighed and recorded. This process is continued at various daily intervals to compare the relationship between strength, cure time and curing conditions.

During this same activity the students conduct silt tests on the sand and slump tests on the concrete mixes before they are placed.

Unit 15 involves an introduction to concrete form construction. For this activity the students construct forms for a flagstone patio and concrete benches. The shape of the flagstones are first drawn on a piece of 4 foot by 4 foot cardboard or hardboard. After the desired shapes are achieved, the six individual shapes are cut out and each student is assigned a shape for which he will build a form.

The original design shape must fit inside the constructed form with no more than one-fourth inch of space at any point. This tolerance is desirable to insure that the individual blocks will fit properly into the larger shape when they are all formed and poured.

The six flagstone shapes become the component modular units of a larger patio made up of four-foot square redwood grids places on a sand base.

We have found that if a number is cast in each of the flagstone shapes, it is much easier to assemble the final unit when it is hauled to the site. When the stones are placed in the large grid, each unit of six is placed in a different direction so that the final effect is that of a random shape. By rotating the module units 90 degrees, the casual observer walking across the patio does not notice similar shaped blocks.

The concrete benches also become an integral part of patio design. The seat for the benches can be either of cast concrete or redwood. When the cast seat is constructed, the concept of precasting and tilt-up wall panels can be conveyed to the students.

This activity is very economical, since scrap lumber and sheet material can be used for the forms. In addition the recipient of the patio and benches has always been more than happy to reimburse the school for the materials involved.

The entire activity can also lend itself to a community beautification project in cooperation with the local parks and recreation district. Most cities are willing to pay the price of the materials for the patio stones and benches to be used in the public parks.

In addition, most schools are able to use the near-non-destructible benches on the school premises. In any case, the cost of the materials can easily be defrayed.

Unit 16 is concerned with the placement and finishing of concrete. In our classes we experiment with a variety of finishes, including smooth steel trowel finishes, a broom finish and an exposed aggregate finish.

We are doing most of our work with the exposed aggragate finish because of its decorative effect and the ease of finishing.

For bench designs where both sides will be exposed and it is necessary to have equal exposure of the aggregate on both sides, we seed the bottom of the form before the concrete is placed. To do this we first spread a layer of damp sand one-fourth inch thick. We then carefully place a layer of the aggregate. The aggregate is generally about one-half inch in diameter or less. This is spread until the layer of sand is no longer visible. The concrete mixture is then placed on top of the aggregate. After the concrete has cured, the surface layer of sand is removed with a brush and the aggregate surface is exposed.

The concrete is mixed after the forms have been prepared, including oiling the forms. The oil provides for easy removal of the forms and prevents the wood from absorbing excessive amounts of moisture from the concrete when it is placed.

The mixed concrete is placed in the forms and screeded even with the top. To prevent voids around the edge, the concrete is puddled with a small stick all the way around the edges. After screeding and puddling, a wood float finish is given to the surface.

After the concrete has been placed and floated, the surface is seeded with aggregate the same size as was applied to the bottom surface. The aggregate is patted into the surface with a trowel until it is slightly covered with a slurry of cement.

We then apply a surface retarder. The retarder allows us to expose the surface as much as 24 hours after the concrete has been placed by lightly washing the surface with a fine mist of water or lightly scrubbing with a soft brush and water. If a retarder is not used, we must watch the concrete very carefully and expose the aggregate at exactly the right time. Under normal curing conditions, the time before exposing the aggregate may range from an hour to several hours, depending on the moisture content of the concrete and the room temperature.

The retarder delays the cure on the top 1/16 inch of the surface and the remainder of the concrete cures normally. The retarder still allows next day removal of forms, but provides for late exposure of the aggregate.

Concrete has become one of the students' favorite activities because most of them have not had very much experience with concrete.

Unit 17 deals with concrete and masonry blocks. The instruction in this unit evolves around sizes and shapes of masonry blocks, masonry mortar, and laying of concrete blocks.

As a laboratory activity, the students lay up a wall section with two opposite corners. The section is laid on building felt placed on the concrete floor of the laboratory.

The mortar mix is a combination of mortar mix and lime. It works like a typical mix, but the mortar can be removed very easily after it cures so that the blocks can be salvaged and used by the next group of students.

We have found that the learning experiences are much better by using two corners on a short wall and laying it up four courses high than if a straight wall section is used or if only one corner is included.

Unit 18, which is the final masonry unit, deals with brick construction. In this unit we discuss the types of bricks, methods of laying bricks, mortar mixes and common tools used in the masonry trades.

The laboratory activity for the brick construction unit involves the fabrication of a small brick barbeque-type fireplace unit that complements the backyard patio design constructed in previous units.

The unit is small and can be lifted into a pickup trick by several people. The size has intentionally been kept to a minimum and the weight reduced as much as possible to facilitate moving. A clay flue is used to enhance student experiences with materials and also to reduce the weight and to facilitate the need for extending the height of the flue.

The fireplace barbeque ultimately becomes a part of the total backyard leisure area

design including the patio and the concrete benches.

The final unit in the course, number 19, is a comprehensive material estimation activity. Considerable time is spent in class discussion covering the various techniques used in material estim on. In addition, take-off tables and schedules have been developed to facilitate the process and to serve as a check-list so that the students will not miss any items in the process. This particular sheet is a check-list which the students use which includes every possible material needed in the structure. As they use the sheet, they give a number to the items used and "X" out any items which are not needed in their particular problem.

As the students proceed with the activity, they enter the correct quantities needed on the take-off sheet. The numbers for the items correspond to the numbers they entered on the previous check-list. This makes it possible for them to determine if they included all materials needed.

Estimating tables have been developed to expedite the determining of quantities needed. For example, if the length of the building is known, the number of floor joists needed for a particular spacing can be determined easily.

The final estimating problem involves determining the types and quantities of material needed to construct the building which has been utilized throughout the course. At the conclusion of the course, the students not only are familiar with all of the component parts of the building but also know the cost of the materials which would be needed to construct it.

The estimating activity requires that the student become thoroughly familiar with the use of building specifications. The same specifications which were introduced in unit four in the blueprint section are now used for estimating.

The estimating involves the calculation of all materials needed to fabricate the structure from the foundation through completion. The students are expected to work at a competency level of 90 percent accuracy. To facilitate the correcting of the activity and to insure that the students are all using the same prices, a price list is provided for them at the outset of the activity.

This concludes the activities that we use in our orientation course. We have found that at this point the students are ready to go to the job site and progress much more efficiently than they have prior to the implementation of this course. Since it has been a suggested prerequisite to our on-site carpentry course, the time required to construct the same house has been reduced by at least 30 percent.

We realize now that the content taught in this course has expedited our instruction tremendously. However, we envision this program or a similar one being equally as successful in the secondary program. It could become a semester course or portions of it could be implemented in existing architectural drawing courses or in a conventional woodworking program as a unit in construction.

The experiences derived from the content will help prepare a student to elect an on-site building trades course and can give him definite insight into what is expected as he progresses in that course.

One of the other instructional medias we did not mention as we presented the units is that a series of crossword puzzles accompany each unit. We have found that crossword puzzles are an excellent method of reinforcing nomenclature. The puzzle forces the student to seek the correct term and also spell the term correctly

As we mentioned at the outset, this content works w ll in the five course sequences. It also fits our original criteria of requiring a minimal budget, utilizes existing facilities, appeals to the student interest and, most important, leads to student employability.

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Teaching Methods

The Impact of Affect in Industrial Arts

William K. Hodgkinson

A brief demonstration lesson preceded the presentation of this document. The thrust of this demonstration was to focus on two diverse modes of instruction, i.e., teacher centered and learner centered.

Let us consider the weather outside. Were it gray and cloudy, we most likely would wear appropriate protective attire and quite possibly feel a bit on the gloomy side. Given a cold and windy setting, we no doubt would be hanging on to our hats. On a hot summer day, we may find ourselves miserably struggling to maintain composure. But no doubt we can find those bright, warm, sunshiny days which simply spew comfort and happiness.

We submit that a climate likewise exists in the classroom. It may not be as obvious as weather, but its signs are usually perceived by the master teacher. It has been called "social-emotional climate in the classroom." (Withall, 1949) In essence it is affect, the realm of human behavior dealing with perceptions, attitudes, appreciations, beliefs, values, interests, emotion sets, biases, ... all of which have a feeling tone.

It is hypothesized that consideration of affect in the classroom is as important as, if not more important than, consideration of cognitive and psychomotor competencies. That is to say, the probability of learning is enhanced in a learner-supportive, learner-centered if you will, atmosphere.

Let us consider for a moment the concept that we have heard so much about motivation. We hear, "get the students involved," "get them interested," but are we not really saying, "get him to attend to what's happening?" What better way to get students to attend than to be receptive and supportive of their feelings? Learning theory has demonstrated that learning occurs within the student, and we can facilitate this mental processing by sustaining the learner. The master teacher is one who has developed his own means of coping with affect in his classroom.

An understanding of interaction analysis techniques or the assistance of a trained observer, possibly your supervisor, are invaluable tools which you might use to assist you in interpreting affect in your classroom. You, the classroom teacher, are one of the most significant parameters in the type of climate in your classroom. Some concepts which are known to have an effect on affect in the classroom follow.

1. When and where necessary be directive in your teaching, but do not always direct the learnint experiences; allow the students the freedom to learn.
2. Demeaning, reproving, disparaging remarks and behaviors certainly do not contribute to a student's self-esteem or sustain his desire to learn.
3. Be humble. Boasting about yourself may be gratifying to you, but it does little to develop the student's self-awareness.
4. A smile, pat on the back, nod, can work as well as praise at supporting student behaviors. You know yourself, the student, and what fits your style of teaching. Why not accentuate the positive a bit more?
5. Accept student responses. Remember they are human, and humans have feelings. Clarify their understandings and help them learn. Be a "facilitator of learning," and structure the learner's problems to enhance his knowledge, skills, etc.

When you return to your classroom, use witting and deliberate behaviors. Think about inner awareness; know what you are doing and have a rationale for why you are doing it. A fully-functioning facilitator of learning must be concerned with the impact of affect in industrial arts education.

REFERENCE

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Computer-Assisted Instruction: A Student/Machine Interactive System

David L. Jelden

The computer, with its many data handling capabilities, is becoming the teacher's greatest educational tool in the classroom. At the present time extensive research is being done in both public and private educational institutions on Computer-Assisted Instruction (CAI). The research completed so far and the proposals which are presently being examined point up many exciting and rewarding possibilities for tomorrow's educational program.

Conclusions which have already been reached as improvements resulting from CAI are as follows:

1. Computer-assisted instruction, across aptitude levels, is as effective or better than classroom instruction with respect to student achievement as measured by written and/or performance tests. This also applies to the attrition rate (drop-out level) of the program.
2. Computer-assisted instruction, across aptitude levels, has the capability to reduce learning time to a significant degree relative to average classroom instruction completion time, in some instances as much as 30 percent.
3. Computer-assisted instruction students, on the average, are favorably disposed toward this mode of instruction.
4. The tutorial approach is a viable instructional method in the presentation of educational materials through computer-assisted instruction.
5. The greatest economic saving for computer-assisted instruction was in the generation and scoring of objective examinations, thus freeing the teacher for diagnostic work and material preparation in the classroom.

Future research already underway is looking at the possibilities of the computer, as a "manager" of instruction, performing a pre-testing option, pre-assessing students' characteristics, personality traits, attitudes, aptitudes and establishment of motivational and anxiety conditions prior to and during the alternative paths which individual learners may take to reach their educational goals or objectives.

In reading about or discussing CAI, it is essential to understand some of the basic terms used so communication can be achieved in the minds of those involved. As a general rule, computer-assisted instruction is basically concerned with two phases. One is an interactive system where the students and the machine continually are responding with one another during the learning process. The second mode of CAI is the non-interactive system where the computer is used to generate pre/post-tests for student use, to prescribe alternatives of instruction in a multi-media environment, or to keep records and accounts of the relative success or failure of the students' progress through the study materials in order to predict the degree of completion in relation to time and level of expected academic achievement.

The non-interactive system sometimes is referred to as computer-managed instruction system where instruction is still performed by the teacher, but all records, scores of tests, etc., are placed into the computer for future use or verification.

In this presentation, we are going to deal with the interactive system and how teachers might incorporate such instruction into their existing classroom.

TERMINOLOGY

Some other terms which those interested in computer-assisted instruction should be familiar with are as follows:

Adaptive Model — A decision structure which uses student input to update and assign individual instructional data.

Adjunct Programming — A programming method in which the instructional program supplements a handbook, study guide, activity packet or some other source of information. The program is intended to instruct the student in the field being studied and is used to expand on the material it supplements. A linear program in an activity packet supplements the textbook, which might be used in answering questions in a student study guide.

Behavioral Objective — A statement that specifies precisely what behavioral is to be exhibited, the conditions under which the behavior will be accomplished, and the minimum standard of acceptable performance. Sometimes called criterion objectives.

Branch — In programmed instruction, a point of choice at which students are sent to alternative items, depending on their responses to a particular item. Usually correct responses send a student on to new information. An incorrect response would send the student to an item which provides information as to why the choice was incorrect.

Bypassing — In programmed instruction, a technique which permits a student to skip certain portions of the material because of prior knowledge. A criterion item may be inserted in a linear program and if the student passes it, he/she is sent forward several items (bypassing); if he/she fails the criterion item, he/she takes an intervening sequence of review or remedial items.

Chaining — The linking together of a series of discriminable responses in a particular order. The completion of each response provides the stimulus for the next response. May involve chains of verbal responses (reciting a list of numbers or key words) or chains of motor responses (following a procedure). The connection made between an input (stimulus) and an action (response). For instance, giving directions on a tape slide series regarding the operation of a piece of equipment which requires the student to do things stated as the procedure is presented.

Educational Technology — The applications of principles of modern behavioral science and technology to education.

Entering Behavior — The student's level of knowledge or skill before instruction begins.

Feedback to Student — Information given to the student regarding the quality of his/her performance.

Feedback to System — Information obtained from student responses which may be used to make adaptive instructional decisions or to revise the instructional program.

Frame — In programmed instruction, each portion of material to which a student makes a response. A frame might also be called an exercise, a step or an item of information. It may vary in size from a single incomplete sentence to a sizable paragraph. A unit of control by TIME which can contain up to 31 lines of information.

Generalization — Learning to respond to a new stimulus similar, but not identical, to one that was present during original learning. An attempt to conceptualize learning.

Hardware - The physical components of a system utilized in instruction, such as A-V devices, terminals, computer storage systems and teaching machines.

Individualized Instruction — A course of study or program fitted to the individual learner's background, abilities and needs, in which the learner has some input into the selection of materials and proceeds at his/her own pace.

Instructional Strategies — The series of decision structures, such as media selection, pacing, difficulty level, readability level, etc., which determine the dynamic nature of instruction.

Instructional System — An integrated combination of resources, techniques and procedures required by the student to achieve specified learning objectives.

Linear Programming — A programming method in which set sequences of frames require a response from the student at each step. The steps are so designed that errors will be minimal for even the slower students in the target population. Each student does each frame in the program, his/her progress differing from that of other students going through the same program only in the rate at which he/she proceeds through the sequence.

Measurement, Criterion Referenced — The process of determining, as objectively as possible, a student's achievement in relation to a fixed standard which is based on criterion objectives.

Measurement, Norm Referenced — The process of determining a student's achievement in relation to other students. Grading "on the curve" involves norm referenced measurement.

Module — An entire instructional unit developed via a systems approach which teaches a specific learning objective or performs a specific evaluation process.

Multi-Media — More than one medium — texts, programmed instruction, audio and video tapes, slides, films, television, computers — used to convey the content of instruction.

Multi-Track Course — A course which employs more than one track or channel of instruction. Course goals are the same on all channels, but course content, degree of instruction and presentation all vary to accommodate students of different aptitudes and levels of previously acquired skills and knowledge.

Performance Activities — Activities specifically related to performance on actual equipment such as laboratory work and supervised motor activities or performance of any job task.

Prompt — A cue or stimulus added to the terminal stimulus of a frame in a program or presentation to make the correct response more likely while the student is learning. It may be pictorial or verbal. It may vary in strength, that is, provide a model for copy or provide a hint of a weaker sort.

Programmed Instruction — A student-centered method of instruction which requires the student to make active responses to instructional materials, provides immediate confirmation of the student's accuracy, allows the student to progress at his/her own rate, and is tested and revised before publication on the basis of student response.

Response, Covert — An internalized response which the student presumably makes but which is neither recorded nor otherwise available to an observer. (Example, student thinks a response.)

Response, Overt — A student's oral, written or manipulative act which is, or can be, recorded by an observer.

Self-Paced Course — A course consisting of materials and activities that allow a student to complete a course at his own rate.

Shaping — A technique which reinforces success approximations, starting with behavior that is already present (questions which can already be answered). Gradually, more difficult material is presented and more sophisticated answers are required.

Software — The technical data, programs and language components of an educational system, as opposed to hardware components. The computer and terminal are hardware, the computer program is the software.

Standard of Performance — A criterion used to determine whether the student has achieved the minimum satisfactory level of performance.

Student Critique — Student feedback to course developers and administrators concerning a given unit or block of instruction.

Systems Approach to Instruction — The series of procedures employed by educational psychologists, instructional technologists and curriculum developers to design and evaluate instructional programs.

Terminal — An input source where data can be placed into and taken from a computer. In CAI, a classroom may have one or more terminals to gain access to the computer.

COMPUTER LANGUAGE

In order for a computer to provide the capabilities of an interactive system, the following requirements must be met: It must have an input terminal, a processor and an output terminal.

To initiate the interactive capability, a form of language must be developed within the machine (called machine language) and a command or shorthand program developed for the terminal operator. As a general rule, a simplified language is developed which directs the computer to provide specific, predetermined operations within the machine. Some examples of this shorthand language are BASIC (Beginners' All-purpose Symbolic Instruction Code) and TIME (Terminal Instruction System for Managed Education).

Each language has its own characteristics and restrictions. For example, BASIC

was developed for engineers who were not familiar with the machine language of the computer but wished to make calculations and check problem solutions written in a more difficult programming language. BASIC, for example, gives the computer a simple command, which then initiates many steps or separate commands within the computer. This process simplifies computer operator knowledge requirements. TIME, on the other hand, was developed for teachers and students as a time-share facility. Teachers in a local classroom could program their course materials into an existing data bank accessible to their students on a request or demand basis through a terminal in the classroom. A teacher in any school district could write an instruction program for a class, store the information in a computer in any local area and have it available to any school district in the region. Access would be on demand by the student from a classroom terminal connected to a standard telephone.

With this capability, each school district or classroom would not have to own a computer but could time-share and take advantage of a large system not being totally used in business or industry. Several such time-sharing educational programs are now commercially available.

AN INTERACTIVE CAI SYSTEM

The best way to initiate an interactive CAI system is to subscribe or lease time from an existing facility. In this way, the terminals and some instructional programs can be provided, and any problems of set-up of equipment can be overcome in consultation with the company representative. In addition, no programming hang-ups are likely to occur, as the system is already in operation.

The main concern of the teacher in a CAI system is to program the course content into teachable blocks adaptable to an existing computer program. This can be done by following the sequence below.

1. Familiarize yourself with the limits of your machine, line length (number of characters), instructional frame length, response frame length, program capability (response mode and selection), print time and print format (diagrams, pictures, etc.). In other words, know the system.

2. Know what the purpose of your program is. Is it general orientation, or specific skill development oriented? Know the age and maturity level of the students who are going to experience instruction and their reading ability level. Understand their motivation, needs and interests as they relate to your subject. All educational programs should be written with an aim or goal in mind.

3. Make an instructional analysis of your course materials. Divide the psychomotor tasks and general informational topics so an exact level of achievement is set for each lesson. Include attitudes you wish to teach, keeping in mind the entry level skills and knowledge the students are likely to bring with them. If necessary, teach these entry level skills prior to lesson instruction.

4. Block your instructional analysis into teachable units where each lesson will run about 15 to 30 minutes. Teach the technical information which is required to perform the operation first, the general or related information last. Guidelines for determining these units might be as follows: Is it basic to a larger body of knowledge? Difficulty of performance frequency of use might also determine the size or sequence of your instructional blocks.

5. Determine the criteria which you will use to evaluate achievement of the lesson or satisfactory performance of the task. Put these into behavioral or performance objective form. Consider also levels of learning expected in relation to time and student ability.

6. Write a sample pre-post examination to check entry level skill and knowledge and to verify if instruction is necessary for the student. This pre-test usually takes the form of an objective multiple-choice test of from 10 to 15 questions over the lesson. Ninety to 95 percent correct response usually determines adequate achievement of the materials.

7. Write the instructional and informational frames for each lesson utilizing the concepts of linear or branched programming. A combination of frames makes a "set" or lesson. The student should not spend more than approximately 30 seconds per frame. As new frames are developed, review and reinforcement experiences should be incorporated into each lesson.

Note: Programmed instruction is compatible with the three major contemporary theories of learning. Advocates of programmed instruction point out the following findings to support their view.

I. Principles Emphasized Within the S-R or Mechanistic Theory of Learning:
   A. The learner should be active rather than a passive listener or viewer.
   B. Frequency of repetition is still imoortant in acquiring skill and in bringing enough overlearning to guarantee retention.
   C. Reinforcement is important and repetition should be under arrangements in which correct responses are rewarded.

II. Principles Emphasized Within the Gestalt, Cognitive or Concept/Principle Theory of Learning:
   A. A learning problem should be so structured and presented that the essential relationships are open to the inspection of the learner.
   B. The direction from simple to complex is not arbitrary, meaningless parts to meaningful wholes, but instead from simplified wholes to more complex wholes.
   C. Learning with understanding is more permanent and more transferable than rote learning or learning by formula.

III. Principles From Personality Theory of Learning:
   A. The learner's abilities are important and provisions have to be made for the slower and the more rapid learners.
   B. The anxiety level appears to be important in determining the beneficial influence of praise or blame.

8. In writing your instructional frames, each possible response to the item should be anticipated, and even the wrong answers should instruct and lead the student to the next frame. Reinforcement is accomplished in this way. Also, an opportunity should be provided to stop the program at specific key points for re-entry at some future time.

9. Program coding of each written frame in regard to text, response and answer should be added to give direction to the computer regarding the next frame or alternative to instruction.

10. Personalize your instruction by providing for the insertion of a first name and by utilizing some humor within the program. Alternative answers, smart remarks, etc., will help relieve the monotony of a strictly verbal program. Use common sense, however, in the number of remarks. Be liberal with praise for a correct answer.

SAMPLE PROGRAM

To give you some guidance in the kind f material which you might prepare for an interactive system, the following few frames are included. They are taken out of context in a sample lesson, but they should give you an idea of the organization and content of an interactive CAI lesson.

Sample Interactive CAI Program

```
F12
X3
T    When we cause electrons to move through a circuit by applying a voltage, __?__ is being
T    done. (Type in the correct word this time.)
T         work
T         force
T         energy

A    Work
R    Correct. Any time any object is moved by any force, work is performed.
D    13

A    Force
R    Come on, we've already said that force is a pressure applied to an object to make it move.
R    Try again.
D    12

A    Energy
R    No, no. Once again, the energy would be the ability of the voltage to cause movement
R    of the electrons. Try again.
D    12
A#
R    Invalid response; Try again.
D    12
```

F13
X3
T Another term you should become familiar with is energy, which is defined as the ability to
T do work.
T When pushing a car, your strength is your source of energy. The more strength you
T have, the more energy, and the more work you can do.
T Any time any kind of work is done, energy must be used to do it.
T When pushing a car you are performing work and using __?__. (Type in and enter
T your answer.)
T force
T energy
T effort

A Force
R Think now. When pushing, you are applying the force which is the same as saying you are
R making an effort. If you have the ability, the car will move. Try again.
D 13

A Effort
R No. You don't use an effort. You make an effort. Try again.
D 13

A Energy
R Yes, you are. If you have no energy, though, you do no work.
D 14
A#
R Invalid response. Try again.
D 13

CONCLUSION

In general, the computer has been shown to be an effective tool for the teacher. Its capacity for handling information, its patience in teaching students, and its availability in modern life make it one of man's greatest assets. Any public school teacher who cannot utilize its existence, prepare materials for its operation and profit from its characteristics in teaching will soon become obsolete in his profession. Let the machine regurgitate factual information. The teacher will then have time to know and work with students on a human basis, interacting with them on human problems and individual needs. If used correctly, the computer can increase the humanization of education.

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Valuing Approach to Teaching Industrial Arts

Richard and Virginia Peter

Within the last few years a great deal of research has been conducted in preparing educational materials designed to help teachers initiate a valuing approach to teaching. The basic theory and concepts of values clarification were developed by Louis Raths, Merril Harmin and Sidney Simon. The techniques for applying the theory to classroom activities were developed by Simon and Harmin and are called values clarification techniques. More recently, other authors such as Leland and Mary Howe and Robert Hawley have developed teacher-student strategies for various subject areas in the curriculum.

Very little has been done in the area of a valuing approach to teaching industrial education. That is the subject of our efforts at Stout, and we wish to share some of the results with you.

The basic theory of values and valuing that we are concerned about today stems from the definition of a value: it is an enduring belief that a specific way of acting or goal of

life is personally or socially preferable to an opposite goal. Values are enduring, but not necessarily carved in stone. If values were values were completely unstable, there would be no continuity in a culture or society.

If we look more closely at these ways of acting and goals in life, or means values and ends values, we can differentiate between several kinds.

Ends values (terminal values) can be either self-centered or society-centered. End-states such as self-respect, salvation or freedom are self-centered (not a negative connotation), while world peace, brotherhood and equality are society-centered.

Means values (instrumental values) can also be seen as two types: (1) Moral values usually refer to those means values that have an interpersonal focus, those which involve other people and their rights. (2) Competence values or self-actualizing values have a personal focus. I can feel I am behaving competently if I am behaving creatively, intelligently or logically; if I am behaving honestly or responsibly, I am behaving morally.

Now it is possible to experience a conflict between two moral values — behaving honestly and lovingly; between two competence values — being imaginative and logical; between a moral and competence value — to act kindly and to offer intellectual criticism. How we resolve these conflicts has to do with our personal value system, or the priority or hierarchy of our values in relationship to one another.

We have said that a value is a belief and it always involves a choice, but there is another aspect to it. Choice without action is sterile. In other words, the preference must be shown in our actions. The process of valuing has been broken down into seven broad skills:

1. Being aware of one's own preferences and valuations. We have to be able to tune in to our feelings, find out what is important to us, know why we are against something.

2. Being willing to affirm one's choices and preferences publicly. If we believe something we should be willing to stand up for what we believe, to voice our opinion. As we reveal ourselves to others, we also understand ourselves better.

3. Making choices on one's own without depending on others.

4. Choosing from alternatives — many people take the first choice that comes along: "everybody in my class is doing it; what else is there to do?"

5. Looking ahead to probable consequences when choosing. Especially when there are alternatives available, e.g., life styles, family styles, we have to be able to look at the pros and cons of each before we choose.

6. Acting on our choices and preferences. We have limited time, energy and money; how we spend our time, money and energy reveals what we value.

7. Acting with pattern and consistency. As we become clearer about our values, we develop patterns of actions and repeat our most valued activities. As we become aware of inconsistencies in our values, we often take steps to change.

We believe that teachers should help students to learn about values and value systems and how they affect our individual lives, our institutions and our society. As industrial educators, we help students develop basic knowledge and skills in selected areas of industry and technology. There is also an increased emphasis placed upon conceptual learning in which students perceive the interrelationships of facts and skills to other industrial experiences and utilize conceptual frameworks for categorizing new information.

There is another level that we feel must be treated in schools, the values level. Many teachers reach it now and then in working with students, but in many cases it is a hit or miss process. We believe that students can learn to bring their values and value systems to bear upon the decisions that they are making in their lives. Students can be taught to sharpen their skills in choosing from alternatives, considering the consequences of each alternative and then making a choice which is supported not only by reason but also by their clearly defined values system.

TEACHER-CENTERED APPROACH

Teachers can begin to plan for this type of interaction of students and values when they plan their curriculum. Questions should be answered in class about the facts and concepts related to the lesson topic. Questions may also bring in the students' personal experiences and values with the facts and concepts that are being learned. This opens the door to questions related to one's values concerning the concepts or other spin-off topics which arise as a result of teacher-student discussion. Once issues have been identified, the teacher can utilize a variety of values clarification techniques (e.g., voting, con-

tinuums, rank ordering, etc.) that help students clarify what their values really are. Students can learn a great deal about themselves and others as they interact at this values level of learning. An important factor for teachers to remember is that the best results will be obtained in a discussion of values when students find an atmosphere of trust and acceptance in the classroom. Students should know that they do not have to reveal or publicly discuss the results of values clarification techniques. They must be aware that they are allowed to "pass" on any topic which might seem embarrassing to them. Experience has shown that attitudes of openness, trust and tolerance of others are best conveyed by teachers who practice them themselves.

The curriculum planning format described above can be adapted to any industrial arts area. It is true that there are topics that you will present in class that are not directly affected by values or do not readily lend themselves to values clarification techniques. However, many opportunities do exist for teachers who are aware of the values aspect of industry and technology and plan at least periodic interaction with students at the values level.

STUDENT-CENTERED APPROACH

Another approach that has been successful is one which gives students the opportunity to brainstorm topics to be studied in conjunction with a study of any industrial arts subject area. Brainstorming requires students to suggest as many topics as possible which relate to the concept that is being studied. Once topics have been identified, the students, individually or in groups, may select one to research. Facts, skills and concepts are discovered and learned by whatever teaching-learning strategies are most appropriate. However, whenever values-related issues are discovered, the following steps may be used to help students determine the basic issues and clarify what their values are on each issue.

1. Conduct a question census; i.e., ask and list questions about the issue.
2. Identify available resources — books, people, other resources — which relate to the issues.
3. Find tentative answers.
4. Discuss these answers with others and develop a response grid which lists possible solutions to the problem together with positive and negative consequences of each:

Example: Nuclear Power Plants as a Source of Energy

	Solution	Positive Consequences	Negative Consequences
1.	Build more	Reduce energy crisis	Danger of nuclear pollution
2.	Improve their design	Less dangerous – more efficient	Costs too much – takes too much time

5. Rank order the solutions from most desirable to least desirable and be prepared to defend the choices that are made.
6. Additional values clarification techniques may be utilized as time and interest permits (e.g., voting on solutions, continuums, forced choices, I learned... statements, etc.).

PROJECT-PRODUCT APPROACH

An essential ingredient in developing values clarification skills is self-awareness. Student projects are often evaluated in terms of design, craftsmanship, finish, etc. Some teachers are now asking students to evaluate their own performance by filling in questionnaires which relate to a student's satisfaction index. This can take a variety of forms.

CAREER DEVELOPMENT APPROACH

Industrial arts instructors have frequent opportunities to help students in making career choices. Values clarification techniques lend themselves readily to career education experiences. Typical strategies include listing of desirable careers, rank ordering of career choices, coding choices according to various categories of pay, hazards, edu-

cational requirements, types of work, etc. The impact of one's values upon these preliminary choices can be explored, with the result that students can identify patterns of choice which may ultimately lead to the selection of a worthwhile career for each individual.

RESOURCES AVAILABLE

The presentation today was designed to introduce some valuing theory and techniques that can be used in teaching industrial education. Time does not allow the development of these ideas in great depth. However, a number of books and other resources are available for those who would like further information and ideas for values clarification techniques.

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Program Enhancement through Club Activity

Roger Jessup, Thomas Pitchford, Robert Stewart and Debbie Wells

Throughout this country, there exist thousands of industrial arts programs. These programs are shaped by various curriculum frameworks that share a common body of objectives. The contemporary and the traditional philosophies encompass many of the same goals. Regardless of the similarities of basic guidelines, a very large percentage of the individual industrial arts programs are unique and innovative. The character of the local programs is shaped by the instructors' efforts in accomplishing objectives through learning activities.

Each industrial arts teacher uses methods that are successful for each particular situation. Teachers quickly find that their choice of activities is limited only by their imagination and desire for student success. Educators generally agree that learners achieve better in programs where they are interested and excited about what they are doing. If a teacher is to make learning exciting, he will use as many methods as possible. Learning becomes meaningful when the student can relate what he does to some tangible, and preferrably short range, goal.

One method of accomplishing educational goals in industrial arts is through club activity. The number of industrial arts clubs in Georgia has shown a rapid increase over the past five years. The Georgia Association of Industrial Arts Clubs has grown from 30 members in 1970 to 130 clubs in 1975. This growth is a direct result of State Department of Education encouragement. Club organizations are now an accepted part of the Georgia State Plan for Vocational Education.

Teachers are finding that many of their objectives can be accomplished through a wide variety of club activities. Perhaps the most commonly accepted objective for industrial arts could be stated: To develop insights and understandings of industrial organiza-

tion, products and processes. This is also the primary goal of the youth club organization in Georgia. Let us consider an example of how club activities can help in the accomplishment of this goal.

Summerour Middle School is located in Norcross, Ga. The school has a population of 900, primarily from low income families. Summerour has one industrial arts teacher. Last year, the 25 club members decided that they would like to take a trip to Disney World in Florida. Needless to say, this trip would be quite expensive. In order to raise part of the money, the club mass-produced a variety of products that were sold in the local community.

Industrial simulations are frequently used at Summerour in the regular industrial arts classes. The mass production conducted by club members was quite different. The difference was in the attitude of the students. The experience was no longer a simulation; it was industry. The club members knew that they had to make a profit if the trip was to be taken. The students took pride in their work, and the products were of higher quality.

In May the club had the money to make the trip. On the way to Disney World, the club spent a day at the Kennedy Space Center. The students were able to learn more about the space program in one day than they would have learned in a month at school. This year, the club had over 300 applications for membership.

Another popular club activity is field trips to local industries. In the Atlanta area the opportunities are limitless. Students enjoy the trips because they offer a break in the traditional school day. Instructors enjoy the trips for the same reason. While visiting these industrial plants, students can observe processes in actual application rather than in laboratory situations. Another advantage of field trips is that they keep the instructor in contact with people in industry. Often these businesses are willing to donate materials and even money to career education programs. In Georgia, one must take advantage of every opportunity.

Another type of club activity that furthers the students' understanding of industry is the utilization of resource speakers. Almost every club invites local people from industry into the classroom to make presentations. We have found that most industries are happy to provide this service.

Industrial arts club competition allows instructors to get to know each other. Each year at Summerour Middle School, the club invites the students from a neighboring high school to attend a foundry workshop. The middle school has excellent foundry equipment, while the high school has none. The students teach each other, and the workshop is usually followed with supper and a basketball game.

Another objective of industrial arts clubs would be the development of leadership skills. A good club organization is designed so that all the activities are directed by the club members. This places the burden of leadership firmly in the hands of the students, with the guidance of the teacher. Not only are there opportunities for young people to provide local leadership, but they have the chance to fill state and national offices. These leadership experiences are invaluable. If our school system is to be successful in preparing future society members, we must prepare students for leadership roles. This is being done through industrial arts clubs.

Another benefit of club membership is the development of decision-making abilities. The ability to make decisions has been identified as one of the most salable skills. In industrial arts clubs, students have the opportunity to experience success or failure based on their decisions in today's schools, students have little opportunity to make choices. When they leave school, they soon learn that life is one decision after another. Through industrial arts club activities, we believe that the student will be better prepared to make choices.

Club activities can be used to accomplish practically any educational objective. The cohesiveness of the group, the realness and competition seem to increase student interest and performance.

Industrial arts clubs also provide valued services to the school and the community. Students take pride in constructing things for the school, such as bookcases or study carrels. These activities help to develop better relationships between departments and the school administration. Many community service projects have been conducted by industrial arts clubs. These projects usually generate good publicity for the club and the industrial arts program. The importance of good community relations cannot be overemphasized.

As in any other part of an industrial arts program, the success of a local club is

dependent on the commitment of the instructor. It takes a lot of time to organize and supervise a good club. To make it exciting for the students, the club must stay active. Most of the activities take place after the regular school day, which means the teacher must give his time. The results produced by a successful club amply justify the time invested by the teacher.

Any teacher now in the field should consider the establishment of a club. It is hoped that the success found in Georgia, in regard to club activity, can be found in other states as well.

IMPLICATIONS FOR TEACHER TRAINING INSTITUTIONS

Student teachers are moving from the status of college student to the role of an instructor. Student teaching experience makes them aware of the benefits that industrial arts clubs can produce for a local program. Teacher training programs should consider increasing their efforts in preparing instructors to supervise club activities.

It is almost mandatory for a new teacher to know what is involved in starting a new, or maintaining an existing, club. Without knowledge of the procedures, it would take more time than a teacher has to get one going. It only hurts the student if the teacher does not have this knowledge prior to teaching. If the teacher is aware of what to expect, the first year of teaching can be a rewarding and beneficial year for the students and instructor as well.

It is easy to take such things as teaching decision-making, leadership and organization for granted. The ideas are easy to understand but difficult to put into practice, transfering the concepts to the students in a manner which they can understand and easily perform. Students should do the decision-making, show leadership and understand the different steps or degrees of organization. Once the officers of a club are elected, the students should be able to take over and assume a lot of the responsibility.

It is an advantage to know ahead of time what is involved in having a successful club. Understanding the concepts before student teaching is important. A club on a college level could be operated in a manner similar to a high school club, so that the procedures would be familiar to the new instructor. Observing other clubs would be a method of realizing the necessary and unnecessary steps to a good club. These ideas are not only good for starting a club, but also for developing a good program in teaching the procedures and processes involved in industry.

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Teacher-Made Media: Coping with Inflation

Richard A. Kruppa and Ronald L. Jacobs

In light of dramatic increases in the amount of new information in all areas of industrial arts and the spiraling cost of commercially produced instructional materials, the teacher has been asked to assume a new role; that of instructiona product developer. Regardless of the sophistication of the planned product, many teachers are reluctant to take on this new role because they are now confronted with problems that are usually foreign to them. Stubborn decisions such as which medium will work best, what kinds of media can be produced easily, what are proper evaluation procedures and finally where can additional information be obtained now face the teacher. The purpose of this paper is to present possible solutions to these questions in a way that will save time and money for the industrial arts teacher. These ideas, techniques and alternatives have been used successfully by the faculty in the Department of Industrial Education and Technology, Bowling Green State University. This paper will concentrate only on those media types

that can be produced easily and delivered with the equipment and facilities normally found in today's schools.

As an introduction, we would like to review why a teacher should use media, especially the industrial arts teacher. One of the broad aims of the teacher should be the development of each individual student with regard to his cognitive, affective and psychomotor skills. And while the teacher lecturing or giving a demonstration might suffice for a large percentage of the students, he is not likely to meet each student's needs. Other media are needed to extend the teacher's effectiveness. This presumes, of course, that the teacher's role is not simply a storehouse of knowledge that is served up to the students. Rather, it assumes that teachers can be effective in helping direct students to the kinds of learning activities and information sources that will be of most usefulness to them. Teachers should be effective managers and facilitators of learning. This is expecially significant to the industrial arts teacher, as he is expected to stay abreast of new developments in the field while trying to live with an inflation-hit budget. One option is to individualize instruction. With this strategy the industrial arts teacher can make more efficient use of his time, especially in the laboratory situation where students frequently work with complex processes and expensive machinery. By individualizing instruction and relying upon support media, the student is presented with consistent instruction and thus reduces the ambiguity of verbal instructions. The teacher is saved from having to repeat the same information several times in a class period and can concentrate on giving needed help to individual students for remediation or enrichment. Media used in this manner becomes a sound educational investment as the teacher's time is utilized more efficiently, reaching more students in the same amount of time.

With respect to media for instruction, teachers have some choices. They can select available media from commercial sources or they can design and produce their own to meet the needs of the learners. Many times, commercially produced instructional materials are less expensive than the same material would be if designed, produced, and evaluated locally. The initial development costs of commercial materials are often spread over an entire market, rather than being concentrated on one system. Even so, according to a large commercial filmstrip manufacturer, commercially produced materials have risen in price on an average of 33 percent from 1970 to the present. Commercially produced materials also are unable to keep up with rapid changes in our field because of the large investments required for the development of each product. These products also must be designed with a large audience in mind so that they can be used with many types of facilities. Teacher-made materials have the advantage of being designed specifically with the needs of the student and facility in mind. If techniques can be devised that will keep the cost of production low while maintaining instructional effectiveness, then teacher-made materials should be more appealing. From an array of instructional materials that could be produced locally, a group have been identified that give the teacher the flexibility and breadth for any instructional strategy. These materials are unique in their advantages and disadvantages when applied; some are better suited for certain situations because of inherent characteristics of form and delivery for a particular situation. These media types range from items that can be used in a one-to-one situation with the student to items that can be used with large groups. The figure shows the various media types that will be considered for this paper, their unique characteristics and a suggested group size limitation in which they can be used effectively.

UNIQUE ADVANTAGES OF MEDIA
(and suggested group sizes)

MEDIA	UNIQUE ADVANTAGE	GROUP SIZE Individual	Small Group	LARGE (25+)
Motion Visuals				
I. Video-tape	a. instant replay can be erased b. dynamic capabilities	x	x	
II. Television (Educational)	a. available programming	x	x	
Still Visuals				
I. Slide Set	a. flexibility of sequence b. self-paced c. can return to earlier frames easily	x	x	x

MEDIA	UNIQUE ADVANTAGE	GROUP SIZE Individual	Small Group	LARGE (25+)
II. Slide set/audio	a. self-pacing			
	b. review possibility if necessary	x	x	x
	c. permanency			
III. Flip-book	a. requires no equipment	x		
	b. self-pacing			
	c. reviewed easily			
	d. many copies can be made, easily reproduced			
	e. good in lab situation			
IV. Transparencies	a. can be used in a lighted room		x	x
	b. allows teacher to face class			
	c. information can be added			
V. Carpetboard	a. wide visibility			
	b. information can be changed			
	c. can be used for live or taped demonstrations		x	x
	d. varying applications		(depends on symbol size)	
VI. Filmstrip	a. permanent sequence			
	b. compact, easily handled			
	c. individual or group students			
	d. can be supplemented with audio	x	x	x
Audio Materials				
I. Audio tape	a. instant replay			
	b. can be erased	x	x	x
	c. original or commercial sources for sound			

MEDIA SELECTION

Before matching the right medium with a given situation, prior stating of the objective(s) is a minimum requisite. The objective should contain the following information: (1) Who will be receiving the instruction, (2) what behaviors you desire from the student as a result of the instruction, (3) under what conditions you expect the student to perform (i.e., what tools, time alloted and learning environment), and (4) what degree of competency he must show to satisfy the demands of the objective. The achievement of the objectives as a result of the instruction should be of the utmost concern for the teacher.

Other items for consideration when making media decisions are the teacher's time constraints, when students will need the media, budgetary constraints and whether or not dynamic motion is required. The media selection process, therefore, becomes an exercise in question-asking.

Who is my student?
What are the behaviors I desire from him?
Under what conditions will he perform?
What are my criteria for judging his success?
What kinds of media can I produce?
What are other considerations (time, budget, dynamics)?

The medium of instruction must be selected on the basis of its potential in achieving the stated objective. Instructional media is, therefore, a means to an end or to a goal.

Following are two case histories of the application of inexpensive media within the department of Industrial Education and Technology.

Case History #1

Several hundred freshman students per year have been taught the safe and proper use of common items of wood processing equipment, including the table saw, band saw, lathe, jointer, single surface planer and others. The method of instruction was live

demonstration administered to small groups within sections averaging about 22 students. Following each live demonstration, some students would use the machine and be checked off as they demonstrated proficiency, while the instructor would continue his live demonstrations of other equipment items. The technique is not unlike much of what happens in industrial arts and carries with it certain inherent disadvantages.

1. Some students may not have a good sight or sound relationship with the equipment or the demonstrator.
2. Variations may exist in the demonstrations over time.
3. Students who are absent miss the demonstration.
4. Much of the instructor's time is used for repetitive instruction that might be used in other activities.

The solution that was devised was to produce a series of filmstrips with audio cassettes. The media were coupled with Singer Study-Mate Autovance II projectors which simultaneously advance the visual program with the audio program. In contrast to the earlier scheme of instruction, each student now receives instruction on the safe and proper use of equipment by taking the media to the machine and following the step-by-step procedures as they are presented. Advantages of this system have proven to be that:

1. Each student receives individual instruction and can proceed at his own pace.
2. The demonstration may be reviewed on demand.
3. The demonstration is uniform from presentation to presentation.
4. Students may be involved in instruction on every machine for which media exist, and all at the same time.
5. The instructor is freed to monitor progress, check-off students as they demonstrate their proficiency and to help individual students.

At Bowling Green, the logistics of dealing with dozens of students using nearly a dozen different filmstrips is handled through a check-out system. At the student's request, a Study-Mate and media package is given to him. The student takes the material to the machine and proceeds.

Case History #2

The same students described in the earlier case history are required to conduct several materials tests, each using a very expensive and sensitive universal testing machine. As a result of the delicacy of the equipment, demonstrations to individual students were deemed necessary. The decision resulted in a heavy burden of personal instruction, yet provided monitoring essential to provide protection of equipment.

In an attempt to reduce the personal contact required, a series of flip-books — brief, programmed instruction booklets — were devised. Each page presents one sequential step required to set-up the universal testing machine for the test required. Photographs are provided on pages where visuals were helpful in understanding the steps of instruction.

To perform the assigned materials test, the student merely follows the sequential steps a page at a time. To insure that the instructor was able to monitor the correct set-up of the equipment, the final step required to use the equipment is not included in the flip-book. Instead, the page asks the student to call his instructor for final instructions. This procedure allows the instructor to check all previous work and to interact with the student regarding the test to be conducted.

PRODUCTION OF MEDIA

Before describing any particular process or technique, it might be helpful to review some pertinent facts about media production. The research in this field has been rather consistent in describing what elements an effective instructional product should contain. Many teachers are disturbed by the fact that anything that is locally produced does not have the professional "gloss" or "shine" that commercially produced materials seem to have. To allay any fears in that direction, it should be stated that the literature has consistently shown that special techniques do little or nothing to improve the quality of learning. (Hoban and Van Ormer, 1950) Embellishments such as color (in video-tape recordings or still photographs), music (in audio-cassettes or sound tracks to other media) and general special effects (fades, dissolves, humor, etc.) have been determined to be generally unnecessary in creating a useful instructional product. (May, 1965-66)

In terms of what is essential to assure instructional effectiveness, the literature again remains consistent in its findings. These elements will be of special concern for

our discussion of the design and production of the media mentioned in this paper. They are: Active learner participation, adequate cueing and content that is carefully ordered and sequenced. Active learner participation in the instruction relates to the opportunities provided for the student to practice or respond to what is being presented to him. This helps increase the probability that the student will remember the instruction through first-hand experiences. Adequate cueing refers to methods or techniques used in the design of the material that helps the student be aware of the intended message. Techniques that facilitate cueing include a subjective camera angle (like looking over someone's shoulder), arrows and pointers on the visuals and directed narration. The learner in this way knows exactly what to notice. Finally, it is essential for efficient learning to order the instruction in a manner that established subordinate skills and those of higher order. The task analysis of the job can give you this information. This is extremely important when students are working by themselves or in a small group without the teacher present. Any confusion in process flow or wording can cause student frustration or, worse, accidents.

The appendix to this paper contains a production analysis of the media that have been described in this paper. Included for each medium type is an introduction explaining broadly this type of medium and its application, a step-by-step procedure of its production, a special section that includes helpful hints and suggestions to further insure the instructional effectiveness of the medium and specific criteria for evaluating its effectiveness.

EVALUATION OF THE MEDIUM

Evaluation is the process by which the teacher discovers whether the medium selected and used was appropriate. In other words, did it do the job for which it was designed? The evaluation process should be used as a tool for providing more information about the materials that you have made, not merely as a means of reinforcing your efforts. What are the things that should be considered as you evaluate your materials? Below are a suggested set of criteria by which you can assess the effectiveness of your medium.

1. Did the medium hold the student's attention?
2. Did the medium fit the objectives of the lesson?
3. Did the medium fit the needs of all the students?
4. Was the environment adequately controlled?
5. Was the content sequenced properly within the materials?

CONCLUSIONS

We have presented an approach to reducing costs involved in instruction through the application of media and have supported teacher-made media. Our experience at Bowling Green University suggests the process is desirable and economical.

APPENDIX

PRODUCTION PROCESS FOR AN AUDIO TAPE

Introduction: Sound can be used as a self-standing media or in conjunction with other media. Most schools today have access to simple-to-operate tape cassette players and recorders. An audio tape has flexibility of use for individual study or for large groups. However, care should be exercised to make sure your equipment can handle the demands of a large group.

Process:
- Step 1: Start with the idea.
- Step 2: Write a complete objective.
- Step 3: Construct a rough draft from the content.
- Step 4: Decide that an audio tape is the most appropriate me[illegible] the objective.
- Step 5: Prepare a refined script from the rough draft. Be aware of pauses that are required for student responses or to coincide with other materials for the student.
- Step 6: Produce tape recording. Attach microphone to a stand so that it need

not be handled during recording. Make a volume check before proceeding (microphone should be about 10-12 inches from mouth). Speak in a clear normal tone and be sure all background noises have been eliminated.

Step 8: Evaluate and revise according to student performance and affect.

Suggestions: At first glance, the audio tape would seem to be a limited media type, since it has no visual message. But the audio tape, used alone or in conjunction with a flip-book, filmstrip, or slade set can be a very effective addition to your instructional arsenal. To synchronize the audio tape with other materials, a low musical tone, door chime, bell or a tap on an object such as a drinking glass can be an effective way of denoting a slide change or a page turn. In this way, the materials can be used independently by a student without worrying about maintaining the proper synchronization between audio and visual materials.

Specific Evaluation Criteria:

1. Is the sound at an appropriate level?
2. Is the quality of the sound distinct and uncluttered by background noise?
3. If used with other media, was the coordination between the media clear and compatible?

PRODUCTION PROCESS FOR A FILMSTRIP

Introduction: A filmstrip consists of a series of illustrations and photographs on 35 mm film in sequence and prepared for projection. A filmstrip can present information, teach a skill or affect an attitude through individual study or through group viewing.

Process: Step 1: Start with an idea.

Step 2: Write a complete objective.

Step 3: Construct a rough draft from the content.

Step 4: Decide that the filmstrip is the appropriate medium for the objective.

Step 5: Prepare a refined shooting script from the rough draft. Decide if you want an audio recording with the filmstrip.

Step 6: Produce the filmstrip. The method explained here will be that of copying illustrations and photographs. A mask must be prepared; by placing two photographs behind the masks and copying them with a 35 mm camera, the correct dimension can be obtained. The camera takes two frames on each exposure and, with successive exposures, a complete filmstrip can be produced. The only limitation is that the original materials must be flat copy. For black and white filmstrips, use Kodak Panatomic X film and the Kodak Direct Positive Film Development outfit. For a color film-strip use Kodachrome or Ektachrome-X reversal films. Be sure to use type B films with tungsten lighting if using color.

Step 7: Deliver to student.

Step 8: Evaluate and revise according to student performance and affect.

Suggestions: In this method of producing filmstrips, all original materials must be flat copies. The mask can be made from a heavy stock matt board or masonite board. The proportion for the mask opening is three units high by four units wide. Remember, all visuals must appear horizontal on the film. The visuals for use in this type of filmstrip can come from magazine pictures, drawings, original titles made with dry transfer lettering or carefully hand-drawn.

Specific evaluation criteria:

1. Was extraneous light controlled?
2. Was the screen appropriately placed?
3. Was the image focused sharply?
4. Was the image large enough for all to see?
5. Was the sound synchronized with the visuals?
6. Was the appropriate screen size selected?

PRODUCTION PROCESS FOR A VIDEO-TAPE RECORDING

Introduction: Locally produced video-tape recordings can be an inexpensive method of showing a demonstration or activity that requires motion. With equipment that is generally available within the school system (i.e., Sony Videorover, recorder, monitor) the teacher can set up a learning station for individual study or for larger groups. Production is easy and video-tape can be erased and used again for future showings.

Process: Step 1: Start with the idea.

Step 2: Write a complete performance objective:
- Audience
- Behaviors desired
- Conditions (time alloted, resources, environment)
- Degree of mastery required.

Step 3: Construct a rough draft from the content.

Step 4: Decide that a video tape recording is the appropriate media for the objective.

Step 5: Refine rough draft into shooting script and later for narration. Remember there's little chance for editing. Everything has to be shot in sequence.

Step 6: Determine production needs, graphs, charts, titles and response questions. Remember all television formats are three units by four units. Lettering must be legible and clear; limit lists or questions to four to five lines.

Step 7: Produce visuals (Wrico lettering, dry-transfer lettering, neat hand printing).

Step 8: Pprepare hardware; area should be clean, quiet and evenly lighted.

Step 9: Shoot program following script. This can be done alone or with another teacher to operate camera. AVOID "talking face" instruction. If you are showing a process or machine, do not include a person standing beside it talking in the camera. The students know what you look like. Show only the machine as the operator would see it. Speak in a clear regular voice into the microphone, off camera.

Step 10. Deliver to student.

Step 11: Evaluate and revise according to student performance and affect.

Suggestions: It is sometimes difficult to have the student respond adequately to a video-tape program. For covert responses (non-written) a frequent technique is to ask the student, "What do you think would happen if I...." Written responses can be asked for by printing questions and presenting them on the screen. Allow time in the program for the student to respond in either case. Remember this is black and white; make sure lighting and aperture setting is suitable to assure proper differentiation between dark-colored parts. And don't forget the overhead projector as a source to display graphic materials for the video camera.

Specific evaluation criteria:

Video-tape Recordings:

1. Was extraneous light controlled?
2. Was the monitor placed for good visibility?
3. Was sound-level set appropriately?
4. Was monitor size adequate for all to see?
5. Are there opportunities for students to review tape at later time?

PRODUCTION PROCESS FOR A FLIP-BOOK

Introduction: Definitely the darling of this department, the flip-book is an inexpensive fast way of presenting sequential material in a self-instructional manner. Given a short instructional activity, flip-books can be used as the prime teaching mode, with the student manipulating the hardware and software at his own pace. Each page of the flip-book contains just enough information so that the student is not overwhelmed with printed instructions, but enough material to maintain continuity. Pictures should be included when needed using Polaroid or regular photographs, color or black and white.

Process: Step 1: Start with the idea.
Step 2: Write a complete performance objective.
Step 3: Construct a rough draft from the content which will include a task analysis of the operation.
Step 4: Decide that a flip-book is the appropriate media on the objective.
Step 5: Refine rough draft to determine visual needs and to make sure all steps are logical and sequential.
Step 6: Finalize production; pictures can be taken with any camera that can get in close enough to show details.
Step 7: Type final script from task analysis and rubber cement pictures as final preparation. Use a primary typewriter for better visibility.
Step 8: Deliver to student (he can work right at the machine with flip-book).
Step 9: Evaluate and revise — observe how easy it is to make necessary alterations.

Suggestions: Flip-books are best used in situations where students respond by the actual manipulation of a machine or process. Evaluation can therefore be determined by just how well the student performs the task. Cueing is easily accomplished by simply adding arrows or labels with dry transfer lettering directly to the picture or page. Attach the pages together by spiral binding, a three-ringed notebook, or by long staples. Flip-books can be considered as a viable alternative to a film-strip/cassette.

Specific evaluation criteria:

1. Is there too much detail in the pictures?
2. Is the information ordered sequentially?
3. Are all instructions clear, requiring no teacher assistance?
4. Are sufficient copies available for all students?
5. Are words clearly hand-printed or large typewriter letters used?

PROCESS FOR PRODUCING A CARPET-BOARD

Introduction: The carpet-board is an inexpensive easy method of displaying materials that present information and develop concepts. The carpet-board itself is simply made of plywood, masonite, or wallboard covered with a short-nap carpet such as kitchen carpet and framed with wooden strips. Display materials can be constructed of heavy cardboard or lightweight 3-d objects. Nylon loop material is used as a backing. The carpet-board can be used for a demonstration for small to medium sized groups or as a display board for video-tape production or slide production.

Process: Step 1: Start with an idea.
Step 2: Write a complete objective.
Step 3: Decide if the carpet-board is the appropriate media to achieve the objective.
Step 4: Organize your content to determine what kinds of display materials you will need.
Step 5: Produce the carpet-board. Our carpet-board is 24 in x 36 in and is covered with carpeting that was given free to the school, as it was a remnant of a larger piece. The carpeting is glued to a piece of plywood and framed with four wooden strips. Display materials are made from heavy cardboard and backed with nylon loop materials.
Step 6: Deliver to student.
Step 7: Evaluate and revise.

Suggestions: The carpet-board should be proportional to either the dimensions of the video format or 35 mm format, whichever way you decide to use it. Another consideration is the color of the carpet. Make sure that it is a dark enough color to produce a dark background for the lighter shaded display materials. Our carpet-board is made from orange carpet, which appears as a dark gray in black and white.

Specific evaluation criteria:

1. Is the board size large enough for all to see?
2. Are display materials large enough for all to see?

3. Is there enough contrast between carpet-board and display materials for easy visibility?
4. If used for video-production, are colors appropriate for tone differentiation?

PROCESS FOR PRODUCING OVERHEAD TRANSPARENCIES

Introduction: Overhead transparencies are large slides used generally for large group presentations. They can show processes, outlines, summaries, or when used with an overlay give progressive disclosure of information. Although they are rather common in use and simple to make, the overhead transparency should be treated like any other media in terms of planning and evaluating.

Process: Step 1: Start with an idea.
Step 2: Write a complete performance objective.
Step 3: Decide if an overhead transparency is the appropriate medium for the objective.
Step 4: Consider the factors that you want your audience to see.
Step 5: Organize the content and make sketches of the layout as to what is to be included in each transparency.
Step 6: Produce the overhead transparency. There are numerous ways of making overheads, but the most common is the heat-sensitive film process and the hand-produced method. The heat-sensitive process requires original material that has heat-absorbing qualities, such as carbon-based ink or a soft lead pencil. Hand-produced overheads can be made using dry-transfer lettering, felt tipped pens, grease pencils, and color adhesives. For any technique, follow basic principles for composition outline in suggestion part of this process guide.
Step 7: Deliver to student.
Step 8: Evaluate and revise.

Suggestions: For overhead transparencies, always select simple, easy to read letter styles. Space letters optically bdcause measured letters do not always look eaual to the eye. Make spaces look equal, regardless of measurement. Separate lines within a caption so that adequate space is left for ease of reading (about 1 1/2 times the height of a lower case letter). Use all capital letters for short titles and labels, but for longer captions and phrases use lower case letters, since the lower case letters are more easily read.

Specific evaluation criteria:
1. Was extraneous light controlled?
2. Was screen appropriately placed?
3. Was image focused sharply?
4. Was image large enough for all to see?
5. Was the image removed when it was no longer appropriate?
6. Was eye contact with the students maintained?

PRODUCTION PROCESS FOR A SLIDE SET

Introduction: A slide set usually consists of 2 x 2 inch transparencies with or without an audio tape. This can be produced in many ways; the more common are by direct use of the camera on a subject or the Kodak Visualmaker for slide copies from books and magazines, and titles made from direct copies of various methods. Titles can also be made by hand-lettering on frosted acetate. The slide series can be used individually in a learning station or with a large group. The teacher has the option of discussing each slide or allowing the visuals to speak for themselves. Delivery to the student is accomplished with a slide projector (and cassette play-back unit).

Process: Step 1: Start with the idea.
Step 2: Write a complete performance objective.
Step 3: Construct a rough draft from the content.
Step 4: Decide that a slide set is the most appropriate media for the objective.
Step 5: Refine rough draft into shooting script and later for narration or for a student study guide.

Step 6: Prepare a scene by scene script for each slide that will be needed. Determine graphic needs; remember 35 mm is proportional to two units by three units.

Step 7: Consider all methods available to produce slides and prepare graphics needed.

Step 8: Produce pictures. Remember subjective camera angle for on-site photography.

Step 9: Deliver to student.

Step 10: Evaluate and revise according to student performance and affect (see evaluation section).

Suggestions: One of the handiest methods of producing slides is with the Kodak Visualmaker. If you can press a button, then you are capable of producing slides of consistent quality from illustrations in books, magazines or from original art work. A big hand-up of many teachers is the production of title slides. This can be accomplished easily by several methods: dry-transfer letters directly on frosted acetate, hand lettering with a grease pencil directly on acetate, Kodalith reversals, or transparencies made from heat process overhead transparency film. It is also possible to "sandwich" slides, originals and identical-sized acetate with eight point dry-transfer lettering, to create more creative effects and accurate cueing.

Specific evaluation criteria:

1. Is there too much detail in the picture?
2. Were the pictures presented in the appropriate order?
3. Was the size of the projected image appropriate for the class?
4. Was screen placed for adequate visibility for all students?

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Innovative Industrial Education in Small Schools

Fred E. Posthuma, Terry J. Squier and Thomas Whalley

Westfield is a small community located in central Wisconsin. The high school has an enrollment of approximately 420 students in grades 9-12. The high school is fed by four smaller communities, each with its own grade school. Because of logistics and cramped grade schools, the industrial education program at Westfield starts at grade 9, offering study of industry. After this introductory course, the student may elect to take energy, communications or materials and processes. We feel we have a progressive program and would like to take this time to familiarize you with the reasoning behind and the operating of the cluster approach to industrial education.

WESTFIELD'S INDUSTRIAL EDUCATION PROGRAM

Westfield is a very small community; within Westfield are three small industries: Westfield Equipment Corp., where hydraulic jacks are assembled, Westfield Creamery, which processes bulk milk, and Brakebush Inc., where they process poultry. The combined employment for the three is 220. The remainder of the community consists of supportive businesses catering to farming, a heavy recreational area and a high number of retirement people.

With the lack of industry in the area, it is difficult to prepare a student for a particular job. In the words of students, "It is difficult for most students to have a definite career goal for Westfield because there are very few job offerings after graduation." "Most students graduating from Westfield enter the service or leave Westfield for jobs elsewhere."

According to the principal, "Westfield High School decided to put strong emphasis on a new industrial education program because of increased student interest and need in that area. In constructing a new program, emphasis was placed upon a diversified program. The desire was to give the student an exposure to a wide range of concepts in industrial education and at the same time give students the opportunity for an in-depth study of a specific concept. In trying to accomplish these goals, the cost factor had to be considered because of limited community resources. The cluster approach used in our curriculum has met our objectives exceptionally well."

While the principal, faculty and Department of Public Instruction were planning the curriculum, Francis Kohn, Superintendent, was busy working with the architect designing a building. The building and the curriculum were modeled around the State Guide for Improving Industrial Education K-12. The outcome was a 10,500 square foot building located apart from the school. The total cost was $240,000.00, including equipment.

The building consists of two main areas: A clean quiet area and a dirty noisy area. This arrangement was chosen for the following reasons: First, a student enrollment of 420 makes it impossible to offer all industrial arts courses as unit shops; second, duplication of costly equipment is unnecessary; and third, due to lack of local industry, the student must be informed of and trained for many job possibilities.

Two teachers were hired to implement the program as a cluster approach. A two-week summer workshop under a NDEA special project aided in curriculum development. The result of considerable hard work paid off in a successful course offering.

A typical student would progress through the program as follows:

The study of industry course has two main objectives. The first objective is to give the students a broad-based understanding of how industry operates. This is done by a study of the 13 concepts of industry.

One such concept, research and development, is learned by lab activities in which the student performs tests. After the lab activities, the student applies his knowledge by combining research and development with packaging. The student researches and designs a package capable of preventing an egg from breaking during shipment. In testing this, a packaged egg is dropped from the third story window of the school without breakage. The students learn by an exciting activity and take pride in a job well done.

The first objective is combined with the second major objective, which is to prepare the student for a wise selection of further study (career goals), and prepare him for student directed learning rather than teacher directed learning. The students achieve these objectives by forming a company to mass produce and sell a product. The students use self-instructional materials to operate the enterprise and further expand their knowledge previously learned. The students share their knowledge by reporting to the Board of Directors. Each student has applied for a job that best suits his occupational interest, from drafting to production and inspection. All the students in the class combine their knowledge and skills to achieve an impressive display of products of extremely good quality.

The final step is sales and the liquidation of the company. What better way to learn than by a careful study, then application of the learning where a student may have a hands-on career exploration?

A conceptually-based materials and processes course should be a hands-on study of how man changes raw materials to a useful product. This is accomplished by a basic familiarization of all areas in the shop. The student experiences 15 different processes by completing self-instructional packages at each area. After a thorough unit on safety, the student experiences processing in the arc welding area, oxy-acetylene welding and sheet metal layoug and bending. The student must complete a simple sheet metal box to include soldering and spot welding; foundry, doing a simple casting; squaring up a block of wood, including routering the student's name; wood lathe, turning a table leg; machine lathe, turning a round stock to tolerance; milling machine; making a square block; and tool room operation.

After the basic familiarization of all areas, the student may contract to learn more about any area, which may include a project. One student decided to do investment casting with the aid of the art teacher. Another advanced student contracted to paint his car.

This is just a brief description of materials and processes. Later in the presentation, we will discuss the course further.

Communications is an inseparable part of our society. Almost everything we do is linked in some way or another to communications. Westfield's communications course is a one-year program designed to provide the student with a broad conceptual understanding of how and why man communicates.

The course is designed around four basic communications modules: Module 1, what is communications? (this module will be explained later in the presentation). Module 2 covers photographic and electronic communications. Module 3 is graphic communications. Module 4 is drafting communications.

A brief overview of the activities included in each module will be given now and a detailed description will be given later in the presentation. Activities in the electronic and photographic communication module include: Producing radio commercials, producing a TV newscast and commercial, producing a slide series, taking and doing basic black and white photography and using self-instructional modules.

The graphic communications module provides the student with a conceptual understanding of the graphic arts industry. Activities are designed to coincide with industrial

reproduction processes. Students follow a 5-section module as a guide to procedures, assignments, and self-instructional activities. Some activities included are: Silk screening, producing stationery or other copy using the offset-lithography process, doing block printing dealing with the historical aspect of letterpress printing and doing several specialized reproduction processes such as spirit duplication and mimeographing.

The fourth module deals with drafting communication. The students learn to communicate using the channels that a draftsman uses. The students begin the module learning the principles behind research and design by using library resources and by having discussions with their peers and instructor.

Basic drafting concepts are learned by doing rough sketches of products and completing rendered illustrations, just as in industry. After a product has been chosen, orthographic and isometric concepts are covered. Technical writing is also included.

During recent years the field of energy has become prominent. We at Westfield feel if one is to learn the total system of industry, a course in energy must be investigated. The study of how man controls, converts, transmits and uses energy is accomplished by study in 4 main modules. These are: Module 1 which deals with the use, conservation and supply of energy; Module 2, mechanical systems; Module 3, fluid systems and Module 4, electrical systems. The following are examples of activities done in each system: Repairing small engines using the individualized packaged information; constructing mechanical systems; dealing with pulleys, levers and gears. Other students are working on electricity kits, learning the basic concepts of electrical energy and conversion. Others are working on fluid power systems, simulating applications of fluid power energy.

With much of the material being individualized, the instructor now can spend more time with individual problems that students may have.

Advanced students work on the contract basis. A student and the instructor work together on writing a contract based upon the objectives of the student.

As a prerequisite, we require all industrial education students to take the study of industry course at grade 9. This 36-week course consists of an overview of the 13 concepts of industry. We believe that these concepts are an essential part of the industrial education program. Since industry affects our everyday life at home and work, it follows that a conceptual understanding of industry is an essential base on which to build further knowledge. The study of flow charts, break even analysis and other technical knowledge can be very difficult for 9th grade students, so we use the student enterprise to generate the motivation and desire to learn.

This student enterprise becomes a vital portion of the course, where the student will experience first-hand career exploration. The students apply for positions ranging from president to janitor, and by simulated job interviews select the best candidate for the job. Through the board of directors meetings and departmental reports, each student observes how every job is performed.

The second major objective of the student enterprise is to gain knowledge of industry. We operate under the principle that students will learn faster and better when the desire or need is present. This desire to learn is developed through hands-on activities. We are in hopes that the knowledge obtained from the course will be in the form of a concept of how industry functions.

Along with the knowledge, the student should develop an awareness of the interdepencency of society and industry. Industry exerts the forces that form our society and affect our students' everyday life. Therefore, they should have an adequate understanding of their environment.

The ability to solve problems of industry and everyday life logically is a key factor in the students' ability to cope with the ever-changing industrial environment. We hope to develop problem-solving ability by a study of the scientific method of problem solving as it relates to the enterprise. We use problem solving in the research and development unit where each student logically solves a problem of industry. One good example is the packaging of an egg.

The last major objective of the study of industry class is to prepare the students for other course offerings in industrial education. Since the other courses are based on individualized study and learning through self-instructional packages, we take great care to prepare the student for this type of learning. This is accomplished by careful transition from the lecture test approach, to self-instructional packages, to student-directed learning.

Student enterprise also gives us an opportunity to inform the student of what follows

in other course offerings. The course content and activities give the student a surface exposure to materials and processes, energy and communications. We feel this is an important step in channelling the student into the area for which he or she is best suited.

To sum up the study of industry course, let me quote from a newspaper article:

> This course more than any other tunes the kids into what is really going on in the business world. It mirrors the actual conditions of industry, while at the same time supplies an overview of its concepts. In short, the study of industry could be considered a small window through which high school students can gaze and even tinker with the mechanisms of industry before they have to go through the main door into the real thing.[1]

Using the knowledge from the study of industry, a student may elect to take materials and processes. We at Westfield believe that a shift to a conceptually based materials and processes course will better equip the student to understand the future demands of industry's ever-changing technology. Our course is a study of man's progress in industry, with an emphasis on how the new processes of today were developed. It includes student involvement and interest via hands-on experiences in the shop area. The course content has shifted from the project to the "how and why" of processing materials. The objectives of the course are achieved by making small take-home projects; however, little emphasis is placed on the project itself. The instructor places most of the emphasis on safety and tool or machine operation. This allows the student the opportunity to stay with a given process until he or she demonstrates a degree of competency. A student whose first attempt is not successful is not discouraged if he or she is using problem-solving techniques to remedy previous errors. The result of this type of instruction is a self-taught concept of materials as they relate to the process.

The student starts the year with a unit on how raw materials are changed to a usable commodity. The study focuses on the four methods of changing materials: Separating, combining, forming and/or conditioning. After a short unit on safety, the student experiences these methods of changing materials by a station-to-station unit. This station-to-station combines the above experience with a familiarization of all areas in the shop. Using self-instructional packages, the student spends 3 days at each station completing a small project. During the station-to-station, the student has one lecture a week discussing the machines and processes. We feel this is an excellent opportunity for the student to experience operations with as many materials as possible.

After this station-to-station, the student will be required to do several teacher-designed projects. Upon successful completion of these, the student will enter into a teacher-student contract. This contract may explore in depth any process previously covered or a specific area of wood, metals, plastics, etc. This teacher-student contract can continue into advanced materials, with students designing a course that will meet their own needs. The teacher places certain requirements upon the student, usually a compromise between what the student wants to learn and what the teacher feels should be learned for a well-rounded education.

We feel that our approach to teaching woods, metals and plastics is unique and will better prepare our students for the world of work. We are convinced that a school our size can offer all areas of industrial education that the larger schools can and at a cost that the community can afford.

The world has entered an era of profound alteration in the traditional patterns and trends in the energy field. Prices, sources and supply have become areas of uncertainty. The day of cheap and unlimited energy is over.

We as industrial educators should increase awareness and place emphasis on the energy problem and its solutions in our classrooms. The student of today will be the adult of tomorrow, whose life style will be determined directly by the conserving of our present resources and the development of new and more efficient sources of energy.

Energy performs the work of industry; thus it is an inseparable part of our civilization. Understanding how to convert, transmit and control energy will better prepare the student for his place in society.

Westfield's energy course is designed to let the student explore these areas of energy through a combination of classroom work and hands-on activities.

The first section of the course is the core. The student concentrates on the use (past, present and future), the conservation and the supply of our energy resources. Here the students, through discussion and group-designed problems, have the opportunity to

present their feelings on the energy crisis. From experience I have found that relatively few of my students know the actual severity of the problem. The first section is designed to make them aware of the problem and start them thinking of possible solutions.

Included in the core is the exploration of implementing alternate energy sources such as sun, wind and tidal energy. Problem solving now becomes a realistic path for the student to follow. Various activities are done to let the student research and design possible solutions to the energy problem.

The core section is very important to the cluster area of energy. The students can build upon their knowledge and relate back to the core when they continue to study the three basic power systems included in the energy course: Mechanical, fluid and electrical. In the mechanical power system the student completes individualized activities that deal with pulleys, gears and levers. Here the student constructs experiments that simulate industrial applications such as the operation of gears in a transmission or the calculation of mechanical advantage of a machine.

Part of mechanical systems is the study of heat engines. One activity included is the disassembly, inspection, repair and assembly of a student-owned small gasoline engine. This is done through a self-instructional package, with slide presentations, that guides the student through the process. Another activity we do is the building of model rockets and testing to prove their design.

The fluid power system includes hands-on activities primarily in pneumatics. It acquaints the student with the relationships of pressure and force and the use of fluids to transmit power. Emphasis is placed on understanding the use and operation of fluid motors, cylinders and valves, and how they fit together to form a total power system.

The last power system in the energy cluster is electricity. Emphasis is placed on the study of electricity as a form of energy and as a means for controlling and transmitting power. Experiments are designed to acquaint the student with the source, control and transmission of electricity.

The uniqueness of this type of approach is that all three power systems are operating at the same time on a rotational basis. Thus the duplication of expensive equipment is eliminated. It is not the easiest way to teach a course in energy, and it takes careful preparation on the instructor's part, but the institution of self-instructional materials makes it possible.

After a student has completed the energy cluster, he may have become interested in some aspect. The may enroll in advanced energy, which operates on the semester time period. Here the curriculum moves from teacher-directed to student-directed.

All advanced courses operate on the same basic principle. The student works on a contract based upon objectives that he wants to learn. Objectives are bargained for and an outline is prepared by the student and the instructor. This allows the student freedom to research in an area that he has chosen to study. It also eliminates the need for separate class hours for each advanced course, since in any advanced period there are students working in all three of the clusters. Another advantage of having advanced courses set up in this manner is that the instructor becomes a resource and guidance person, able to give individual help where needed.

Let me give you an example of an energy contract. I had two students interested in solar energy. We write a contract with objectives and an outline. The students did research, writing letters to companies and reading all available materials. They then designed and constructed a solar panel and are now testing it with some fantastic results.

Seeing these two work, as well as my other students, gives one a gratifying feeling of accomplishment that can be gained nowhere else but in industrial education.

> Human beings are, above all, communicators. Language is the most distinctive of man's capacities, and most of the great works of human history reflect, in one way or another, man's efforts to communicate. Yet the technology of human communication has been relatively slow to develop. The advent of written language a few thousands years ago, and the development in Europe of the printing press in the fifteenth century, were contributions of tremendous significance; but not until the twentieth century did we see a rapid proliferation of communications technology. Photography and film making, radio and television, the telegraph and the telephone, the transistor and the electronic computer have vastly increased the capacity for communication within the human community. Industrial education would hardly be complete without an examination of the costs and benefits of these remarkable developments.[2]

Westfield's communications course is designed to provide the students with a broad conceptual understanding of communication and its relation to industry and life in general.

The first module of the course poses the question, "What is communications?" Here the student begins by defining communications in terms of himself and in relation to others. Understanding yourself is the beginning of successful communications. To do this, he must examine several topics, the first of which is called the communications model. This is a model that all forms of communications must follow. It begins with the initiator of the act of communications, the sender, and follows the model to the receiver.

The student is faced with the question of what causes communication problems. Understanding interference, which causes communication breakdowns, and its elements better prepares the student to cope with communications problems that he will be faced with in industry and society.

The student also discovers that he is not the only communication participant, but also discovers that he is not the only communication participant, but also that machines are communicators. Machine technology is increasingly becoming an efficient communication tool.

What are the elements that affect our total communications? Here the student looks at perception, creativity, meaning, symbols and other elements that affect the way we, as humans, communicate. After exploring these elements, the student can better attempt to express his thoughts, wishes and needs to others.

The advent of the industrialized society saw the need for communication by people within industries. The other modules, photographic and electronic communications, graphic communications and drafting communication are designed to let the student explore these communication industries with hands-on experience.

First, let us look at the photographic and electronic communications module. Here the students explore the vast electronic communications industry, with related activities such as producing a television newscast containing a sports and weather section and including a 30-second commercial. A studio is set up using a video tape recorder. Jobs such as cameraman, producer, actor, etc., are assigned in the group so that each person has a part in the production. Setting of the studio is stressed. Students make weather maps and cue cards and dress up on the day of production. The students enjoy this activity very much because they role-play real jobs using the television media.

Another activity is to let students produce radio commercials. Here the students become "famous air personalities" while learning the proper techniques for radio communication. Advertisements are of every type. Everything from new "Kissy Lipstick" to advertising a local store product were produced.

In photography two activities are required. The first is doing basic black and white photography, where the student follows self-instructional packages designed to allow flexibility in individual learning speeds. Most students enjoy this activity because of the freedom of expression it leaves them. It may also be used later as a hobby.

The second is for a group of students to produce a slide series with audio narration. Programs ranging from a comedy called "Klutz County Hospital" to instructions on "How to Make a Pizza" have been produced. The processing of the slides and the taping of the audio are done right in our shop.

We are continually acting and reacting as a result of printed communication in one form or another. In the third module of the cluster, graphic communication, the student learns the various industrial processes of communication using printed images to convey a message. Hands-on activities let the student experience the major printing processes. Activities such as silk screening a t-shirt and making stationery let the student communicate a message while using one of the processes. Emphasis is on the process and not the project.

Man is a consumer, and his goods are manufactured or constructed. This concept reinforces the fourth module of the communications cluster, drafting communications. In order to relate drafting most effectively to an industrial process, the students follow the industrial sequence from research and design all the way to packaging.

In research and design, the student is faced with a design problem similar to one that may be found in industry. He must state the problem and do research on it. In doing this, the student will learn design elements and principles. After this, he learns how to sketch so that he may communicate his idea. He refines his sketches and decides to make technical drawings in order to manufacture his product. The mechanical manipulations of drafting are now brought to use. Thus a student learns about the drafting industry

through actual hands-on experience. He must write specifications and thus enters the area of technical writing. All activities unite to make up the entire drafting communications industry.

After the student completes the communications cluster and has gained an insight into the various careers offered, he may choose to go into advanced communications. Here the program is student-directed and works on a contract basis as described before.

Three years ago the Big North Vocational Cooperative was formed to offer capstone courses in power mechanics, building trades, model office and health occupations to senior students from six cooperating school districts. The larger student base allowed offerings which, until the establishment of the cooperative, were unfeasible in any one small school.

We like to think of the cooperative as more of a concept than a physical plant. The concept allows for sharing among all schools or only between those interested. It allows for cooperative in-service curriculum projects such as the one just presented.

In this particular case we worked with two schools — Tri-County and Westfield — with similar philosophies. Another essential trait would be the willingness of the teachers. As you have noticed, there is no lack of enthusiasm on the part of the teachers in this project.

Curriculum development appears to follow much the same evolution in most cases. First comes the identification that a change is needed; the teachers express an interest in change. Next is the planning stage which allows for brainstorming, visitation to other projects, universities, etc. The first trial materials are written and tested with students. At this point we realized that much more curriculum development time was needed. We also continued to build up our curriculum resource library and adapted what others did to the needs of the local program. When more individualization takes place, much more organization is needed and more software and prepared materials are needed. Contracts are very time-consuming but appear to be a useful tool for the teachers involved in the project.

If you are frustrated because you teach in a small school, why not investigate the possibility of cooperating with a neighboring district? Things can start happening for you!

FOOTNOTES

1. Marquette County Tribune.
2. Source unknown.

Mr. Posthuma teaches Communications and Energy at Westfield High School.
Mr. Squier teaches Study of Industry and Materials and Processes at Westfield High School.
Mr. Whalley directs Big North Vocational Cooperative and is the vocational coordinator for Almond, Montello, Tri-County, Wautoma, Westfield and Wild Rose school districts in Wisconsin.

Educational Games in Today's Learning

Roger A. Smith

Education is currently in the midst of great change. In recent years topics such as student motivation, relevancy and individualized instruction have been of interest to many educators. These concerns have led to curriculum changes, but more often to changes in teaching methodology. During the last decade instruction has been directed toward meeting the needs of individual students through child-centered teaching methods. Employed in these techniques are extensive use of such educational materials as learning packages, performance contracts, films, television, and computers.

Because individuals learn or obtain meaning from their surroundings differently, one method of instruction does not bring equal degrees of success to all students. To optimize the learning process, instruction needs to be adapted to each individual's abilities and modes of learning. With the increased emphasis on personalized instruction, it has

been realized that education will not adopt one educational technique as the best method and disregard all others. On the contrary, more methods will be developed to complement those already in existence in an effort to meet the needs and styles of each individual.

One teaching technique which has recently received much attention is gaming. Educational games have been known by many names. They have been called models, simulations, games, similated games, role-playing exercises and many more. The lacking commonality of terminology is due to the diversification of the technique's origin and the uniqueness of each educational game produced.

EDUCATIONAL GAMES — TERMINOLOGY AND TYPES

Simulations

Simulations are models of physical or social situations. These have two basic characteristics, the first being that reality, whether physical or social, is represented on a reduced scale. The second characteristic is that reality is portrayed in a simplified form. In other words, only selected components of reality are included in the model. Physical models are constructed of many products and are often used to show their exterior appearance without simulating the intricate internal working parts. Likewise, social models are often developed as training aids to simulate a limited aspect of business or industry.

Role-Playing

Role-playing is often confused with social models or simulations. Most social models involve role-playing, but not all role-playing can be classified as simulation. Role-playing can be defined as a portrayal of those activities and attitudes possessed by one in a specific position or role. Role-playing qualifies as a simulation when the roles portrayed accurately correspond to those actually in that role in the real process or system. On the other hand, one's interpretation of what a role is, such as a youngster playing teacher, does not constitute a simulation because it does not accurately portray the real role.[1]

Games

Games are contests played under predetermined rules for the purpose of winning. This definition does not differentiate between casual games and educational games. There are many similarities between the two types, but educational games have explicit, preplanned educational purposes and are not played just for entertainment. Student enjoyment and interest has been one of the strengths of educational games, and this characteristic should not be destroyed but rather used to advantage. Dr. Clark Abt stated: "Games may be significant without being solemn, interesting without being humorless, and difficult without being frustrating."[2]

Games may be simulations, but they need not be. The primary distinguishing factor between games and nongames is their competition. Games stimulate competition between players and culminate in a definite winner and loser. Noncompetitive simulations, such as production lines, chemical reactions, or traffic flow, are not considered games, whereas business simulations in which the participants try to increase their profits have winners and losers and are therefore classified as games.

Even though the terminology used in connection with this subject and the definitions are not agreed upon by all, the factor which distinguishes games from other activities is its competition. Most subjects and activities in which there is competition among members with definite winners and losers can be called games.

Simulation Games

Simulation games are those activities which combine the characteristics of both simulations and games. They are models of physical or social situations in which there is competition, with definite winners and losers.

HISTORICAL DEVELOPMENT OF GAMES

Games have their origin steeped in history but were not used in education for learning purposes much before the early 1960's. Games in education originated from simulation games in the business community. The business community, in turn, borrowed the technique from military training.

Military Games

Military games, or war games as many are commonly called, date back many centuries. One of the oldest war games is a form of chess which was used as a stylized or symbolic representation of war. Other early games similar to chess have originated in many parts of the world and are thought to have the same purpose.

As war became more complicated and abstraction was more developed, other military games were developed. Some of these were played for pleasure and others were used for instructional purposes. One of these games was "Kriegspiel," first played in 1798, which used a map and outline of rules which the soldiers followed.[3]

During the 1800's military games began to align themselves into distinct groups. These were the rigid and tactical war games. Rigid games were more of an academic training in over-all war strategy. The games covered realistic situations which required much preparation, the use of charts, maps and tables. The unpredictable changing patterns of the war were introduced through the use of dice. The second type of war game was used for tactical training. These games employed great realism and were played by large numbers of soldiers.

These early games developed by the Prussians have now spread through the world and are part of the training of every military force in existence. Since the nineteenth century, war games have become highly sophisticated and their operation has lent itself to computer processing.

Business Games

Over the years of military game development, the business community saw applications for techniques similar to those used by the military. With the expanding need for qualified management personnel, those in business began analyzing training methods. The methods used in formal education, such as lectures and seminars, did not actively engage the student in the real world of business. Much of the information in this type of presentation was factual and poorly remembered or did not have immediate application and therefore was forgotten. The second common type of training was on-the-job learning. This method was highly desirable; however, it was relatively slow and learning was limited to the job encountered. Also, mistakes made while learning were costly to the industry. Because of this, a new training technique had to be developed which would incorporate the desirable aspects of both types of training.

In 1956 the American Management Association developed what was probably the first game for business management. It was called the "Top Management Decision Simulation." This game and others were used to allow the participants interaction with real life situations. Participants were confronted with problems and they had to make decisions based on their knowledge and gained experience.[4]

Educational Games

The first use of educational simulation and gaming, as reported by Tansey and Univin[5] and Boocock and Schild,[6] was in 1962 in a project known as "Jefferson Township School District." This early simulation game, developed to train educational administrators, was similar to that used in business. The administrators were presented with various situations and were asked to react to them.

The use of games in the classroom fell into two general classes. The first use was to aid students in developing skills and learn course content. This technique was developed by Layman E. Allen, a professor at Yale, and notably was in the area of mathematics and logic. Many of the early games were played using dice and tended to be highly competitive. The second type of classroom game attempted to teach social or moral concepts. Guetzkow, Alger and 'ers at Northwestern University and Coleman and Boocock at Johns Hopkins Universi ere the leaders and pioneers in this field. These games tended to employ real situations and nations put under fictitious names. Games of this nature were more highly simulated, with less competition than those of the first type. Games of the second type have developed more strongly than those of the first, especially in the area of the social sciences. One of the major producers of this type of game has been Abt Associates, Cambridge, Massachusetts.

VALUES OF GAMES

The technique of gaming has grown since its early development, and many educators and researchers have indicated that the technique offers advantages to the educational process.

The most predominant characteristic of gaming is the enthusiasm generated within students. Games are highly motivational because students enjoy them. They look at games as a form of play. Research has shown that those who have played simulation games have expanded their interest in the subject of the game and have gained intellectual confidence. The degree of complexity and structure of games has had a direct relationship with the degree of concentration, understanding, confidence, and satisfaction experienced through the game.

In addition to motivational effects, games tend to lead to a high level of involvement by those who participate. Games provide direct experience with the topics dealt with in the game. Students learn through the actual manipulation of game components. They analyze individual components in the game model and learn how these should be combined to obtain desired interaction to win or succeed. This allows an opportunity to sense the structure of the game variables.

In the conventional classroom, the teacher must play a role as guide and evaluator. He must lead pupils through learning and at the same time criticize and judge them. Games and simulations tend to break down the direct one-to-one lines of interaction between the teacher and the individual student and open up interaction between the students. The teacher now acts only as a guide because the game itself acts as the judge by rewarding or punishing certain behavior or actions. The winner is determined within the framework of the rules of the game and not by an evaluation from the teacher.[7]

Games provide a means for students to learn peer interaction. In all games the participants experience competition and tension to overcome the obstacles in the game and achieve the stated objectives to win. In some games this competition takes the form of one player individually competing against another. In other games cooperation among players is needed to compete successfully against other players. In still other games, one competes against himself or a standard.

Games aid in developing efficacy. Students learn through games that they can have an effect on their surroundings. Most games depend on the action and ability of the student to apply what he knows for success. From this the student sees that his behavior has a direct relation to the outcome of events.

While students learn that they can affect their own environment, they must also learn that in life, as in most games, there is an element of chance or fate. Through games players learn that information is not always accurate, machines break down and nature can cause disasters to occur. The element of chance adds realism to the game and teaches that bad luck can not be avoided, but its effects can be reduced with good planning.

Games as well as simulations can be used to acquaint students with situations which could be found in real life and yet do it quicker and without the long-lasting consequences which would be found in life if failure is encountered. This value adds a feeling of realism and relevance to the classroom. The fear of reproof and failure often deters students from entering into traditional instructional methods, whereas with gaming the student is not held to the effects of his mistakes and is only beaten by the system rather than being criticized by the teacher.

The values of using academic games in the classroom are many and varied. Like any other teaching methodology, gaming has its disadvantages as well as its advantages. Some have felt that games are a gross distortion of reality and tend to introduce naive misconceptions of the game topics. Others have felt that games introduce a given set of values, and students are not given the opportunity to establish their own values. Games offer the disadvantage of being limited in the types of physical, psychological and social contexts in which they may be placed. Cost associated with some types of games, particularly computer games, has been extremely high and therefore one limiting factor. Another disadvantage to gaming is that not all fields of education have commercially produced games, and those who produce their own games are limited by the time it takes to develop a game and their own creativity.

GAME CONSTRUCTION

Game construction is difficult, and those in the field concede that game design is still in its early development. There are no concrete steps to follow to achieve success. The success of the game design thus far has been erratic in nature and relies primarily on imagination rather than established techniques.

The first and most important step in designing a game, as with any other instructional

method, is to identify the objectives of the game. One must know what is to be learned or taught through the game. Games can generally perform three functions or fit into three general categories. These include, first, the learning of facts. Fact-type games can reinforce already known material or teach new material. A common example of this type game would be one designed using arithmetic flash cards. The second general classification of games are those which teach about something or teach a process. An example of this type of game is "Legislature." In this game, students play the roles of representatives trying to get bills passed by the legislature. Players learn about the process of government through the game. The third type of game is one during which the students extrapolate concepts on their own, using what they learned through the game.

The second step in the construction of a game is to determine the mode or model which can best teach the stated objectives. Various modes can be used such as cards, dice, boards, role-playing, computers, writing and construction. Models, either physical or social, can also serve as the major agent in achieving objectives through games. If a model is selected, it must be defined at this stage in the design process. A model must be developed which is simple, manipulable, and significant.

The third step in constructing a game is to identify the players as to their nature and number. Some games require many different types of players to work as a team. Other games require only one person to take each position. The size of the team and number of each type of player is determined by the number which can demonstrate the model effectively. The classroom needs and limitations should be considered when making these decisions.

The players must have resources to manipulate or exchange in competition with other players. These are decided upon and must take a form consistent with the game mode or model. Resources may be such things as troops, money, votes, products and the like. The resources should have precise value so that players can assess their position and progress during the game and facilitate determining a winner at the termination of the game.

Fifth, the players must engage in some activity or exchange of resources. This activity must be clearly defined, and specific objectives or goals for the players must be stated. These may be to collect points, make money, advance one's position on a board, capture so many of the enemy, collect so many votes and the like. These goals will in most cases be far different from the over-all educational objective for the game itself.

For most games, a set of limitations or rules must be established to state what is acceptable activity and what is not. Time or point limitations may be necessary to determine certain stages of the game such as the end of a battle or termination of a hand of cards. Criteria also need to be stated to determine the end of the game. In some games the limitations or rules imposed are very elaborate and strict, while others are relatively simple. Some games encourage the breaking of the rules if players feel they can get away with it, but they must also be willing to pay the penalty if they get caught.

Finally, some games require a certain amount of background information to set the stage before play may begin. For example, a discussion of a historical situation describing the various players, their motives, backgrounds and objectives may be necessary to function in a particular model. This information may take its form in written commentary, audio or video recordings, pictures, slides, or any other means of presentation.

After a game has been written, it must be tested by actually playing it. This is the only way to see if all players are equally involved, to determine the time needed to play the game and test the rules of play. After testing, most games need revisions to improve their playability.

One of the most important considerations in game planning is the after-game discussion. Games provide a point of departure to bring out the educational objectives for the game. The teacher should try to get the students to verbalize about their feelings and actions during the game. Students should state the real world applications or implications brought out because of the game. Also, many students have questions regarding certain aspects of the game and the real world counterpart. These aspects of gaming must be considered and used to their fullest to achieve the maximum value of the gaming experience.[8]

EVALUATION

Less material has been written on the subject of game evaluation than on any other aspect of gaming. The success of individual games to date has been of an erratic nature.

This is due partly to the lack of concrete evaluation criteria. However, due to the varying nature of each individual game, it is difficult to establish criteria which would apply to all games.

There are several questions which should be asked about a game which might provide some measure of its success. First, how valid is the game? To be valid it must accomplish the educational objectives which were predetermined at the beginning of the design stage.

A second factor to consider in evaluation of a game is its coverage. Does the game really represent the subject portrayed? Coverage would seek to determine the degree to which a game represents its real world subject. This question is particularly applicable to those games built on physical or social models.

Comprehensibility should be considered. There are two areas of comprehension to be evaluated, the first being the comprehension of the game itself by the players. Are the students able to understand the game operation? Care must be taken to explain the game and make it as understandable as possible. Understanding must not be confused with simplicity. Games should not be unnecessarily complicated or confusing; however, they may be structurally complex to make them more exciting and challenging. The second area of comprehension is that of the real world subject of the game. It is important to determine the degree to which the game portrays the desired concept.

Closely aligned to the last consideration is the degree to which a game is structured. Is the game playable? The rules must be evaluated to determine whether they needlessly restrict players or the action of the game, or whether there are enough rules to cover all situations.

A fifth factor to consider in game evaluation is the degree of competition and participation of the players. These two factors are very important to make the game interesting and exciting for the students. Without these two factors, many of the values of games, such as motivation and interaction, are not present.

The ultimate area of evaluation is educational value. Questions regarding the degree of learning which takes place during gaming must be evaluated in light of the game's educational objectives.

GAMING RESEARCH

The results of research studies in the area of gaming have been as diverse as their purposes. Smith[9] found that students could learn factual material using computer simulation games. Studies by Harvey[10] and Conte[11] found similar results. A study by Lunetta[12] found that cognitive information could be learned more effectively using gaming and loop films than conventional classroom approaches. In studies by Anderson,[13] Curry and Brooks,[14] Stadsklev[15] and Cherryholmes,[16] the conclusion was that students could not learn significantly more using games than traditional methods.

CONCLUSION

Educators need to be aware of differences within individuals and the effect that differences have on ways in which students seek meaning from their surroundings. Individual differences must be realized and various educational methodologies be available to students to meet instructional objectives. Students should be allowed to select alternative instructional techniques, enabling them to capitalize on their unique skills and abilities. One technique which offers excitement and involvement is educational gaming.

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Videotapes and Individualized Industrial Education

C. R. Worsfold

College Community Schools is situated on the southern-most edge of the city of Cedar Rapids. The campus includes Prairie Elementary School (kindergarten and first grade), Prairie View Elementary (second and third grades), Prairie Intermediate (fourth, fifth and sixth grades), Prairie Junior High (seventh, eighth and ninth grades) and Prairie High School (tenth, eleventh and twelfth grades).

The College Community School District, located in Linn, Johnson and Benton counties is in east central Iowa. It encompasses a 12 square mile portion of the city of Cedar Rapids, the incorporated towns of Ely, Fairfax, Shueyville, Swisher, Walford and all or part of six townships.

With an estimated population of 11,000 in an area of 136 square miles located on a 140-acre site, the College Community School District offers a comprehensive educational program to 3,000 students from kindergarten to the twelfth grade.

College Community Schools was awarded funds from Title III of the Elementary and Secondary Education Act for production of instructional videotapes over a three-year period: 1974, 1975 and 1976.

The grant, entitled "Development and Evaluation of Individualized Video Taped Learning Packages," includes funds for construction of an underground network of TV cables from Kirkwood Community College to the College Community schools buildings nearby, a distance of about one and one-half miles. All five buildings on campus have this underground television cable hook-up to Kirkwood. However, only the high school is operational at this time.

An extension of the grant for two additional years will enable the College Community School District to produce some 1,500 videotapes through the services of Kirkwood and their television production center.

Within the three-year period, the proposed project is to convert traditional curriculum in the areas of high school industrial arts, business education, home economics, language arts, physical education and art to a self-paced videotaped format through professional production of individualized learning packages at Kirkwood Community College's production facility. The tapes are to run 5 to 20 minutes, with most averaging 12 minutes.

Videotaped instructional resources and programs available through commercial broadcast and also videotaped programs or demonstrations originating in Prairie High School are planned to be used as needed.

Fifteen color monitors were available the first year, with seven additional color monitors added the second year. Handbooks with written objectives, additional activities and resources accompany all courses.

> The TV system does not replace the teachers, but actually allows them more time to be professionals. The function of a teacher is to diagnose, prescribe and evaluate ... to be able to diagnose a student's learning problem, assist students in setting their goals and evaluate a student's performance, not just dispense information.

Videotapes lend themselves to the process of individualization by:

- Allowing for self-pacing. Students can view the videotapes as often as necessary.
- Allowing an alternative method of learning, other than reading materials only.
- Allowing the student to become more responsible for his learning. Effective videotapes tell students exactly what they should be able to do.
- Making instruction available to students whenever they need help instead of always having to wait for the teacher to be present before they can begin.
- Allowing for variable entry. Whenever a student moves to College Community Schools from another school, or when he desires to take a course, he may do so.
- Dealing with the short attention span concept in learning — most people are able to concentrate for a period of only about 12 minutes.

HARDWARE

Twelve cassette players are housed in the TV Distribution Center at Kirkwood Community College. These 12 video cassette machines feed channels 2-13, using modulators. Each of the 12 channels has a monochrome monitor. The output of these modulators feeds through one and one-half miles of buried cables using two-way amplifiers. Five telephone-intercom lines are buried between the buildings so students can call for video playbacks. Prairie High School is completely wired with 53 TV jacks and 20 intercom stations. The other four buildings have TV and intercom systems in the buildings, leaving only the internal wiring of the building to be completed.

SOFTWARE

First year production of 475 videotape information packages included: RECORD-KEEPING, OFFICE MACHINES, PHYSICAL EDUCATION, WOODS, MACHINE OPERATIONS, DRAFTING AND MEDIA. During the second year of production, AUTO MECHANICS and BASIC ELECTRICITY tapes were added to the industrial education tape banks. The tapes are produced on one-inch format in color, using Kirkwood's television production facility which includes color cameras, film chain, character generator and other hardware.

Each tape employs a single concept or objective. Groups of tapes and associated handouts are used to individualize a course or a section within a course.

ACTION-ORIENTED TELEVISION VIEWING

When a student starts a program of study, he receives an instruction sheet that contains the objectives and appropriate videotape he is to watch. He then proceeds to a telephone located close to the television receiver and calls the distribution center. When a call is received in the distribution center, the operator locates the tape and finds a vacant channel. If all channels are full, he consults the automatic timer. This allows the operator to quickly ascertain when the first tape will be completed; he can thereby inform

the caller what channel he will be on and how soon. Since most of the industrial arts tapes average 8 minutes or less we have very few waits in excess of 60 seconds. The student then merely turns to the channel selected and receives his information package.

Tapes have been programmed to run for only a few minutes so that students may view several tapes, or the same tape several times, during a regular class period or whenever they have a limited amount of time.

GROWTH OF A VIDEOTAPE

The instructor records the script he has created on an audio cassette tape... (for each module produced a teacher writes objectives, organizes materials and produces a script, recorded on a cassette).

A typist transcribes the script into a rough form. It is then routed in turn to the project coordinator, the administrator of the video project and the director of educational media at Kirkwood Community College, for editing and revision, acceptance, or rejection. The instructor makes needed changes and revisions; it is typed again and proof-read. Then the script is sent to Kirkwood, where it is viewed by the production manager. Once the script is edited and approved, visuals are prepared and tape production gets under way. The audio portion is taped first, then the visual, synchronizing the two.

Now the script is sent to the production manager, who works with the camera men and the instructor to put the videotape onto a master tape, later dubbing the production from the master tape to a cassette. Finally the cassette videotape is placed into the system.

Complete records are being kept in order to compute the total cost involved, as well as the cost of each phase in the production of each tape.

Mr. Ken Steine, principal of Prairie High School, is the key person in the videotaping program. He administers the program directly, plans the workshops, enforces the rules and regulations concerning scripts, dictates changes in the second year continuation which he wrote and even spends a great deal of time examining each script — giving the project direction and keeping it all together.

A continual in-service program has been established. Mr. Steine, the administrator of the program and the program coordinator get together weekly throughout the school year with instructors working on current videotaping projects to discuss problems and deadlines and to handle situations as they arise.

OTHER POTENTIAL USES OF VIDEOTAPE

Self-Evaluation Tool for the Teacher

A camera can be placed in any teacher's classroom during a period of instruction; the film is to be viewed later by the teacher, who can see himself objectively and note improvements to be made or compliment himself on a job well done. The teacher can also ask others to objectively analyze the presentation. It would be a teacher self-improvement process rather than an administrative evaluation.

Magnification and Visual Display

A video system can be used to magnify and display implements, graphs, book pages and any other items which require magnification for presentation to large classes or laboratories.

Data Storage and Retrieval

Videotape can be a useful archive medium for the storage of certain aural and visual resource data in a convenient retrieval form for direct instructional use, lectures by visiting authorities, musical performances by groups and artists, interviews with primary sources in history and so forth.

Student Self-Evaluation

In such areas of study as speech training, acting, or musical performance, for example, a videotape system can provide the possibility of recording this performance for analysis by the student, his classmates, or his instructor at a later time.

Testing Materials

Television can be employed to devise special test materials. This technique is particularly valuable where the student needs to be tested on his discrimination of phenomena

which are not reducible to writing; for example, the specifications of a particular micro-organism in a mixed culture or the identification of a certain stagecraft technique manifesting the actual presentation of a play. One national TV network has used a sort of testing format successfully on several occasions in connection with informal lessons about highway safety and current events.

Mr. Worsfold is a member of the faculty of Prairie High School, Cedar Rapids, Iowa.

Tools

Numerical Controlled Equipment

Clifton P. Campbell

The purpose of this paper is to present a description of numerical control (N/C) operational devices. The classifications of design and drafting, production equipment and inspection and testing are used for organizational purposes.

OPERATIONAL DEVICES

The scope of N/C applications has tended to be essentially limited by economic feasibility and man's ingenuity. Thus, it can be applied to any operation that requires controlled motion.

Design and Drafting

Numerically controlled drafting and plotting machines have many uses. Among them are: Preparation of preliminary design drawings from mathematical descriptions; verification of tool and cutting path data on machine control input media; contour mapping; layout of printed circuit artwork masters and inspection templates; architectural drafting; automatic drafting of complex three-dimensional shapes such as aerodynamic surfaces, automobile bodies, ship hull forms, tire treads, impellers and turbine blades.[1] These machines are also used to prepare various graphical forms such as graphs and charts from numerical data for analysis and verification.

Numerically controlled drafting machines. A complete computer-aided drafting system consists of a digital computer and N/C drafting machine. Drafting machines are connected directly to a computer or are off-line and use computer output as a control media. The off-line mode of operation is normally used because of the time disparity between the electronic speed of the computer and the mechanical speed of the drafting machine. Initially, mathematical descriptions in numerical form are prepared by a part programmer and processed through a computer, resulting in coordinate data encoded on magnetic tape, punched cards, or punched tape. This output constitutes a set of detailed instructions which are used by the N/C drafting machine to produce a graphical presentation.[2] Input media is fed through the reading device of an N/C drafting machine and processed by the control unit. Control output signals drive a pen, stylus, or optical exposure head on the drafting machine to produce an accurate, quality drawing on various materials, at speeds greater than those obtainable manually. All types of lines and forms can be drawn in a number of widths and colors. The N/C drafting machine can provide mirror image or reverse drawings, scale up or down, rotate, translate, and project data to any desired view.[3] Some models have full alphabetic and numeric printing capabilities. A number of N/C drafting machines have digitizing capabilities for the acquisition of coordinate data to define points, lines, and curves on existing drawings or patterns.

A representative example of an N/C drafting machine is the Series 600 control unit and Model 22 graphic display table manufactured by the Gerber Scientific Instrument Co. This is a solid state continuous path system with buffer storage, a sequence number display, and a linear interpolator. It can draw at the rate of 150 inches per minute with accuracy of ±0.007 inch and can scale the size of a graphic presentation from half size to 16 times size.[4] A drawing head, with an optical turret for automatic selection from six different drawing tools, is positioned by an X and Y carriage which executes the commands of the control unit. Positioning along the X axis is achieved by a rack and pinion gear train adjacent to the precision table ways. The Y carriage, basic tool holder, is positioned along the X carriage by a helical lead screw. Digital stepping motors are used in the basic drive system of both axes.

Numerically controlled plotting machines. Plotting machines are similar in concept and operation to N/C drafting machines. The differences are primarily in the degree of accuracy and the quality of the graphical presentation that can be produced. The plotter is an X-Y positioning system which can plot computer output as it is being generated or operate offline using computer output as a control media. When the plotter is used on-line, the plot data and control commands are supplied through interface electronics. In the off-line mode of operation, which is normally used, magnetic tape is played back on the control unit which supplies the X and Y axis drive signals, mode selection signals, and Z axis commands to the plotter.[5] Many N/C plotters have mirror image capability and drawing scale flexibility. They are available in flatbed and drum models.

A representative example of an N/C plotting machine is the Calcomp Model 565 drum plotter manufactured by California Computer Products, Inc. It has an X-Y axis plotting speed of 18,000 steps per minute and a Z axis (pen) speed of 600 operations per minute. Bidirectional stepping motors are used to position the X and Y axes. Plotting is regulated by the movements of a pen relative to the surface of the paper, with each input pulse causing a step of either 0.01 or 0.005 inch. The X axis deflection is produced by the motion of a rotating drum, and the Y axis deflection is produced by the motion of a pen carriage. Command signals raise and lower the liquid ink or ballpoint pen from the surface of the paper. All plotting, discrete points, continuous lines, or symbols, is accomplished by the stepping action of the drum and pen carriage. Paper alignment is maintained by sprockets on the drum. Various types of roll stock paper and mylar, either 12 or 31 inches wide, and blank or with grid markings, are used. Manual controls for positioning the drum and pen carriage and for raising and lowering the pen are provided. Controls to initiate any of three modes of operation, search, single plot and multiple plot, in addition to miscellaneous tape modes such as fast, forward and rewind, are located on the front panel of the control unit.[6]

Production Equipment

Numerical control has been adopted more extensively for use by production equipment than by any other area of application. The general acceptance of this technological innovation came about as a result of its inherent qualities of increased accuracy, increased production and interchangeability of the end product.[7]

Drilling machines. A large number and variety of N/C drilling machines are marketed. The key advantage of N/C drilling is the elimination of the high costs associated with positioning jigs and fixtures.[8] Numerically controlled drilling machines are available in a variety of models, from two-axis machines with single spindles to three-axis machines with automatic tool changers or turrets. Most drilling machines have some milling capability.

Typical of the smaller types of special purpose N/C drilling machines are printed circuit board drills. These machines are equipped with single or multiple stations. A drilling machine designed for precision drilling of a large number of holes in printed circuit boards or other flat stock manufactured by the Edlund Division of the Monarch Machine Tool Co. It has four stations, each with a cluster of four drill spindles with independent feed and speed control. The positioning table is mounted on the base, along with a column which holds a vertically adjusted bracket fitted with independent air feed units of four groups of four units each. The drills are automatically selected by programmed information, and the positioning speed is 200 inches per minute.[9]

A typical general purpose, two-axis N/C drilling machine is the Moog Model 83-200. This representative example of a point-to-point vertical drilling machine capable of limited straight line milling along the X and Y axes has a single spindle with manual or

mechanical Z axis control and manual tool changing. The pneumatic-hydraulic positioning control system positions at the rate of 180 to 200 inches per minute with ±0.001 inch accuracy. Control and positioning components used in this machine are manufactured by Moog, Inc., and are fitted at the factory to a specially designed and built Bridgeport vertical mill.[10] The machine control unit (MCU), attached to the head of the machine tool, contains a pneumatic block reading device, manual input dials and a mechanical sequence counter.

Another successful application of N/C drilling is turret drilling. The turret head functions to some degree as an automatic tool changer. The number of tools used — six, eight, or ten — varies with the design of the turret. Numerically controlled turret drills are capable of cycling automatically, selecting tools and positioning the table and carriage in the X and Y direction. Both two- and three-axis control systems are used. A typical N/C turret drill is the Burgmaster Model 3 BHT-3, manufactured by the Burgmaster Division of Houdaille Industries. It has double housing planer type construction which provides maximum strength and precision for large workpieces. The machine tool has an eight-spindle turret and is equipped with a General Electric Mark Century MCU. It has a three-axis positioning control and can perform milling and boring operations, in addition to drilling.[11]

Milling machines. There are n any types of milling machines, such as die sinkers, contouring and profiling machines, skin and spar mills, as well as general purpose knee and bed types. They are generally classified as horizontal or vertical types.[12]

A representative N/C horizontal milling machine is the two-axis Cincinnati milling machine, with an Acramatic 220 solid state point-to-point MCU, manufactured by the Cincinnati Milacron Co. The MCU is equipped with a tally tape reading device, manual input decade switches, and sequence number and position displays. In addition, it has full range zero shift capability. A 33-1/4 by 48 inch work table handles workpieces as heavy as 5,500 pounds at milling feedrates of 2 to 30 inches per minute. The table is positioned by a 7-1/2 horsepower hydraulic servo motor driving a ball nut lead screw. Third axis (Z) control is facilitated through manually set cams. This N/C machine tool is also capable of drilling, tapping and boring operations.[13]

A two-axis Cincinnati vertical N/C milling machine with an Acramatic 220 point-to-point MCU has machine control unit and other components identical to those used in the horizontal milling machine. A 20 by 40 inch work table which handles workpieces as heavy as 1,500 pounds is positioned by a five-horsepower hydraulic servo motor. In addition to milling, operations such as drilling, tapping and boring can be performed on this machine.

Boring machines. Numerically controlled boring machines, with from two to eight axes of movement, can be equipped with point-to-point or continuous path control systems. They are classified as horizontal or vertical machines.[14]

In horizontal boring, a horizontal spindle and cutting tool remove metal by rotation of the spindle. The workpiece is located on a table which can position in the X and Y direction, and in some cases a rotary table is used for 360 degree positioning. This type machine can be used to bore, mill and drill. A horizontal boring machine manufactured by the Lucas Machine Division of the New Britain Machine Co., the Lucas Model 542B120, is equipped with a three-axis continuous path machine control unit. A rotary transducer is mounted directly on the end of the lead screw, which is driven by a hydraulic motor and serovalve.[15]

A vertical boring machine consists of a large rotating table to which a workpiece is attached. An adjustable rail containing the cross rail head or heads is mounted on columns. The head(s) move in or out on the rail. In addition to boring, turning and other operations similar to those performed by vertical turret lathes can be performed. A single head vertical boring machine manufactured by the G. A. Gray Co. has an integrated circuit two-axis continuous path MCU with linear and circular interpolation.[16] Commands from the MCU determine the speed of a rotating table driven by helical and spiral bevel gears powered by a DC motor. A five tool indexing turret attached to the end of a ram can be extended into deep holes.

Turning machines. Some of the different types of N/C turning machines or lathes are the horizontal turret lathe, vertical turret lathe, engine lathe, and chucking lathe.

The horizontal turret lathe (bar lathe) is generally used for multiple cuts such as drilling, boring, reaming, tapping, facing, turning, and parting off detail parts from ran-

dom length metal bars. A representative N/C horizontal turret lathe is a Jones and Lamson Model 4518-NCTL three-axis turret lathe with a General Electric Mark Century MCU, manufactured by Jones and Lamson, Division of Waterbury Farrel Co. The MCU has facilities for manual data input and manual operation, as well as tape control for turning. The turret lathe carriage and cross slide respond to linear and circular interpolation of programmed information for continuous path turning. At the same time, the saddle responds to end point positions for the third axis of motion. Each slide is positioned by an electric or hydraulic motor driving a ball nut lead screw. A rotary resolver, driven by the lead screw, provides feedback to the closed loop system.[17]

The vertical turret lathe is used for multiple cuts such as facing, turning and/or boring of parts too large to be machines on standard-size horizontal lathes. The vertical Giddings and Lewis turret lathe is equipped with a four-axis N/C point-to-point control system. Two of the four axes control the ram head, while the other two control the side head. Commands from the MCU index the turret and determine table speeds. The work table is driven by a variable speed DC motor with a high and low gear. When equipped with a continuous path control system, this machine uses an Inductosyn linear feedback device for each axis under control of the MCU.

The engine lathe is usually used for turning parts between centers, or for facing, turning, boring, or single point thread chasing on workpieces that can be held in a chuck or collet. A representative N/C engine lathe is an American Model 3220 two-axis N/C engine lathe with a General Electric continuous path MCU. It is equipped with resolvers for shifting the zero reference of each axis. An operator's control station mounted on wheels facilitates locating the push-button controls near the carriage of the lathe or in any other convenient place. DC motors operating from silicon-controlled rectifiers drive ball nut lead screws for feed control.[18]

The N/C chucking lathe is used for turning, threading, facing, drilling, boring, reaming and other operations. A representative example of an N/C chucking lathe is the Monarch Pathfinder, manufactured by the Monarch Machine Tool Co. It is equipped with a General Electric Mark Century solid state 100S machine control unit. The chucking lathe has a hexagonal turret and two tape-actuated auxiliary slides. Two-axis continuous path control of the turret with circular interpolation provides the capacity for generating almost any part configuration within the size limitations of the machine.[19]

Machining centers. Thus far in the description of N/C production equipment, drilling, milling, boring and turning machines have been described. Some models of these machines, with automatic tool changers, might fall into the machining center classification, when they are capable of performing different operations, such as drilling, milling, boring, tapping and reaming. Full automation is one characteristic of a machining center; all system functions are numerically controlled.[20] Machining centers are manufactured in different configurations based on classic combinations of beds, columns, saddles and tables. Optional features of machining centers include multiple spindle heads, shuttle pallet systems, dual tape readers and as many as five axes of machine control. A representative N/C maching center is the Kearney and Trecker Milwaukee-Matic unit, manufactured by Kearney and Trecker Corp., equipped with a point-to-point and continuous path control system which provides positioning and two-axis (X and Y) contouring. It has random tool selection and changing. A pallet shuttle, for the reciprocal machining of a workpiece, automatically transfers a pallet with completed part off the index table and presents another to the machining station.[21] This reduces nonproductive time associated with part loading and unloading.

A maximum of 60 preset tools can be loaded, at random, in a chain type tool storage magazine, with one additional in the spindle. The tool storage magazine rotates automatically on command of the MCU and exchanges the preselected tool in the spindle.

Grinding machines. Grinding is a metalcutting process accomplished by the controlled rotation of an abrasive wheel against a workpiece. Numerical control is applied to grinding because of its ability to control contours and provide close tolerances.[22] A representative example of an N/C contour grinder is the Numera-Tool, manufactured by the Ex-Cell-O Corp. This three-axis vertical contour grinder is equipped with a Bendix Dynapath Model 1503 continuous path machine control unit. The integrated circuit MCU is designed to accept computer interface or punched tape input. The machine tool has a 24-inch diameter turntable and a vertical worm gear driven servo controlled spindle. A motorized spindle, mounted to a horizontal servo controlled cross slide and affixed to the vertical servo controlled slide, powers the grinding wheel. Maximum

traverse rate in the linear axes is 200 inches per minute, and the maximum rotary speed of the workpiece spindle is 30 revolutions per minute.[23]

Punching and notching machines. Punching or piercing produces a hole in sheet or thin plate material. Numerical control makes it possible to select any location, size and shape of hole. Two basic types of N/C presses which provide single stroke piercing have been developed. One is the single station type where tools are manually changed during the cycle, and the other is a turret type which automatically indexes tools into position.[24]

Single station machines hold one punch and die at a time. Numerical control is used to position a workpiece in relation to the punch and die, for punching holes, notching, blanking, nibbling and forming. A representative single station punching and notching machine is the Strippit Fabramatic Model 30/30 two-axis machine, manufactured by Strippit Division of Houdaille Industries. It facilitates short-run production of large complex workpieces. Round or shaped holes, notches and cutouts of practically unlimited variety are punched automatically. Although normal operation is automatic, semi-automatic and manual modes are provided to verify machine control tapes, check performance, or manually operate the machine.[25]

A turret type punch press can process a completed workpiece in a single setup. A representative example of a turret type punching and notching machine is the two-axis Wiedematic Model A-30 turret punch press, manufactured by the Wiedmann Division of Warner and Swasey Co. It is equipped with a General Electric Mark Century point-to-point MCU. Power is provided by rotary hydraulic motors with closed loop servo-valve control and resolver feedback. Both the carriage and cross slide are driven by rack and pinion gears. The 30-station punch turret can be rotated in either direction. All positioning functions, as well as turret indexing, occur simultaneously. In addition to punching round, square, or a variety of oval shaped holes, the machine notches, nibbles, pierces and centerpunches.

Tube bending machines. Operation of the N/C tube bender consists of positioning a tube, solid bar or wire, and then bending it to the desired angle. Improved accuracy, additional versatility and automatic operation resulting in decreased production costs, inspection time and scrap are a few of the advantages of N/C tube bending machines.[26] Tubes are bent into a variety of configurations and used by aerospace, aircraft, machine tool, appliance, automotive and other industries. N/C tube benders are used for bending [illegible] and heat exchanger tubes where relatively few of any one shape are required, although the individual part might have many bends and must match precisely with its mating members. A representative N/C tube bending machine is the Pines Numri-Form Model NC-2 N/C tube bending machine and Cybermat integrated circuit MCU, manufactured by the Teledyne Pines Co. The machine control unit is a point-to-point three-axis system. An electronic memory unit in the MCU stores data for as many as 24 bends. Manual and punched tape input are used. Punched tape extends the use to workpieces requiring more than 24 bends and permits accurate duplicates or original runs.[27] A feature of this machine is its ability to sense and measure the degree of material springback in a bend and then overbend to achieve the desired angle.

Flame cutting machines. Numerically controlled flame cutting machines are used to cut plate stock for large fabrications, such as earth moving equipment, steel structures, bridges, ship hulls, tanks and others. This equipment eliminates the need for templates, scale drawings and reliance on a skilled operator to control flame cutting processes. Continuous path control directs marking, punching and scribing for layout purposes, in addition to flame and plasma arc piercing and contour cutting in steel plate.[28] An example of a bridge type N/C flame cutting machine is the Tape-O-Graph unit manufactured by the Air Reduction Co., with a General Electric three-axis Mark Century MCU. The Tape-O-Graph performs plate marking, straight line and contour cutting, ripping and squaring, plate edge preparation and contour beveling, as well as mirror image and dissimilar contour cutting. Both flame and plasma cutting are possible. A coordinated drive system, powered by servo motors and a rack and pinion drive, permits longitudinal and traverse motions to position simultaneously.[29]

Large fabrications such as ship hulls, bridges and tanks are designed with the aid of a computer which performs fairing of lines between points. The computer output is a machine control tape used to operate the flame cutting machine which produces smoother and more accurate curved surfaces.

Welding machines. Numerically controlled welding is the result of demands for improved standards of welding quality for aerospace activities.[30] In addition to positioning

the workpiece to be welded, factors involving the welding cycle are automatically controlled. A Sciaky five-axis N/C fusion welding machine consists of five main elements.

One element is a traveling column ram manipulator which carries the welding head. A second element is the weld positioner and tailstock unit which holds the workpiece to be welded. A third element consists of the fusion welding equipment, which is under the control of the MCU. The fourth element is a servo system, which employs static solid state power amplifiers, to control the current to DC drive motors. The fifth element consists of a Bendix solid state Dynapath five-axis continuous path MCU with manual and punched tape input. Machine movements in five axes and the temperature of the welding arc are controlled simultaneously by the MCU with repeatable accuracy.[31]

Filament winding machines. Filament winding is the technique of spinning strands of tough fibers over a mandrel and impregnating them with a resin to form a vessel. Taking maximum advantage of the high tensile strength of a filament permits strong, lightweight construction for a variety of vessel shapes, such as rocket motor cases.[32] Numerically controlled filament winding machines provide filament path control and tension during fabrication so that the strength of the reculting vessel coincides with directional strength requirements. A representative N/C filament winding machine is the three-axis machine manufactured by the Rohr Corp. and equipped with a Bunker-Ramo MCU. The machine can wind pressure vessels as much as 8 feet in diameter and 18 feet long.

Component insertion machines. Numerically controlled component insertion machines are used in the manufacture of printed circuit boards. A component insertion machine inserts, cuts and clinches the component leads, assuring proper circuit contact and improved solderability. A variety of means for supplying components to the machine are used. One method is to use an N/C device for selecting, and then stringing different electrical components in proper order.[33] A Universal Model 2521 automatic axial lead component sequencer is manufactured by the Universal Instruments Corp. After a reel of components has been prepared on equipment of this type, it is loaded onto a component insertion machine which inserts the components into a circuit board. A representative component insertion machine is manufactured by the Universal Instruments Corp. and is equipped with a General Electric Mark Century MCU. It positions two circuit boards simultaneously, inserts the electronic component leads into the proper holes, then cuts and clinches them.

Wire processing machines. Machines controlled by punched card or punched tape input media provide an accurate means of processing different sizes and types of wire from reels. Numerically controlled wire processing machines measure, mark, cut, strip and coil sections of wire so that they are ready for use.[34] A point-to-point Datex Model WPM-100 wire processing machine, manufactured by the Datex Corp., is approximately 20 feet long and is equipped with a machine control unit capable of automatic, semi-automatic, or manual control.

Another process is wire wrapping, by which insulated conductor wire is automatically fastened to terminals with solderless wrapped connections. Electronic or electrical assemblies which have a modular terminal arrangement can be wired by this equipment. A representative N/C wire wrapping machine is the Gardner Denver Model 14F wire wrap machine manufactured by the Gardner Denver Co. It strips insulation from one end of a wire fed from a barrel or bulk spool, wraps the end around a predetermined terminal, lays the wire along a preselected path, cuts it to length, strips the other end, and wraps that end around a second terminal.[35] The machine consists of movable carriages containing wire wrapping tool assemblies and dressing fingers which are positioned at modular points to give the desired wire pattern. This machine is designed so that either punched card or punched tape input media can be used for automatic operation. Fault indicating circuits are provided to facilitate constant inspection of machine performance and output during operation. Errors in programming or operation are detected, thus decreasing panel inspection time and rework.[36]

Fabric cutting machines. Numerically controlled fabric cutting machines provide a unique system for automatic cutting of fabrics and fabric-like materials. This equipment combines the versatility of manual cutting machines, guided by an experienced cutter, and the accuracy of automatic die cutting. A representative N/C fabric cutting machine is the Cincinnati fabric cutting machine and Acramatic IV machine control unit manufactured by the Cincinnati Milacron Co. The MCU controls the feed rate and the positioning of the reciprocating blade and fabric. A machine table unit, on which layers of fabric are

consists of two separate synchronized endless conveyor belts driven at variable speeds. A bridge which supports a movable cutting head spans the machine table.[37] An adjustable holding device under and across the bridge contains two pairs of rollers spanned by a friction pressure belt to prevent the fabric from buckling. The carriage located under the table provides support for the cutting blade and synchronized with the upper carriage to control the blade through the layers of fabric. The movable cutting head contains three electric motors. One motor ensures that the edge of the blade is pointed into the cut, a second motor powers an automatic blade sharpener, and the third motor drives the reciprocating blade at 3,600 motions per minute.[38]

Routers and shapers. Numerically controlled woodworking routers and shapers are designed to provide fast cutting with high spindle speeds and feed rates. A representative N/C woodworking router is the Ekstrom Carlson #444 Rout-O-Mill, equipped with a two-axis Bunker-Ramo machine control unit, manufactured by Ekstrom, Carlson, and Co. All functions, such as point-to-point or continuous path cuts, spindle up or down, spindle start or stop, turret stop index to varying cutter depths and mirror image, are controlled by the MCU. A 24- by 72-inch work table, mounted on 4 hardened and ground guide bars, holds a workpiece, while a moving column and ram traverse the area. Ball nut lead screws, driven by hydraulic servomechanisms, position each motion from 0 to 400 inches per minute.[39]

Miscellaneous production equipment applications. The following machines are further examples of N/C applications in production equipment.

A numerically controlled screwdriver resulted from the coupling of an automatic screwdriver with a hopper feed and apoint-to-point machine control unit. This assembly is manufactured by Dixon Automatic Tools. A holding fixture mounted on an X-Y table accommodates two workpieces. The depth motion, used to drive the screw, is manually set.[40]

One attempt at N/C riveting employs an automatic drilling and riveting machine to fabricate aircraft fuel tanks. Manufactured by Omark Industries, the machine can accommodate airframe sections as much as 120 inches wide and 40 feet long. The N/C machine drills, countersinks and installs 16 rivets per minute. An N/C positioner rotates, elevates and tilts a workpiece to the desired angle. The machine head clamps it, drills and countersinks the proper size hole for a rivet stored in gravity hoppers. A rivet head then performs the riveting.[41]

An N/C shot-peening machine uses small hard steel shot hurled at high velocity to hammer the surface of a workpiece into compression and thereby increase its fatigue life. The Vacu-Blast Co. manufactures a five-axis N/C shot-peening machine. It has 25-foot travel capacity along the X axis, 5 feet along the Y axis and 5-1/2 feet along the Z axis. A boom on which the nozzle is mounted rotates 360 degrees, while the nozzle itself moves 135 degrees. Various mechanical motions and the peening operation can be controlled automatically or manually by an operator at a control panel.[42]

A shearing machine controlled by N/C is manufactured by the Cincinnati Shaper Co. It is programmed by a computer which selects the best sequence and pattern to shear a given size sheet with the least amount of scrap. Computer output in punched card form is placed in the shear's card reader. Automatic control then provides for the positioning of front and back gauges, energizing probes, positioning of the delivery chute and shear cycling.[43]

An N/C coil winding machine controls wire cutting, wire placement, cementing, loading and ejection of an empty bobbin and finished coil. The MCU activates sequential or simultaneous functions and assures automatic timing, regulation of the number of turns and control of motor speeds. Coils can be programmed and encoded on punched card and punched tape input media, for more turns at one end than the other and for midcoil taps.[44] A coil winding machine manufactured by the General Electric Co. counts the number of turns per coil, indexes to the next coil, counts the number of indexes and stops at the end of a cycle.

Inspection and Testing

Numerical control inspection and testing is a logical extension of N/C because it fulfills an increasing demand for improved accuracy, speed and reliability in the inspection and testing of parts manufactured by N/C production equipment.[45] The criteria for inspection and testing with N/C are similar. In each situation, the machine is programmed to measure the variable under consideration and to display and/or record the data resolved

from the measurements.

Inspection machines. Numerical control inspection is particularly advantageous where verification of the physical geometry of a workpiece is necessary or where measurement determination of the unknown geometry of a workpiece is required. An N/C inspection machine consists of a probe or sensing head, facilities for positioning and holding the workpiece to be measured and a means of making and either displaying or recording the measurements made on the workpiece. These machines provide alignment along two horizontal axes and, in more sophisticated equipment, motions in the vertical axis as well as one or more axes of rotation or tilt.[46]

A representative N/C inspection machine is the Lucas four-axis N/C inspection measuring machine manufactured by the Lucas Machine Division of The New Britain Machine Co. It is equipped with a machine control unit which has built-in computer memory, permitting programmed patterns or routines to be stored and used on command. Among these routines was one for automatic hole finding with the aid of a probe. It has the ability to determine the center, diameter, and coordinate location of any hole in a workpiece, and to compare this information with input data. The machine is designed to perform automatic or semi-automatic measurements of the physical dimensions of a workpiece and record this information on a typewritten hard copy printout and/or punched tape.[47] It is capable of measuring between any two points not over 12 inches apart on one axis, with an error of ±0.0005 inch and with repeatability of ±0.0001 inch. Inspection of a known three-dimensional workpiece is accomplished by programming two axes (either manual or punched tape input) and probing the third. Inspection of an unknown three-dimensional workpiece is accomplished by providing arbitrary coordinates in the non-probe axes and probing by means of manual input in the third axis. The machine has four axes of movement, vertical, transverse, longitudinal and rotary. These axes are controlled by a closed loop electrohydraulic servo system.[48]

Testing machines. Numerical control is used to check printed circuit boards, as in the case of a pre-assembly testing operation. An N/C system requires only that a board be plugged into a module check unit. The appropriate test and limits are programmed and coded on punched tape, which then directs the test activity.[49]

An example of a testing machine under numerical control is a device manufactured by the Bunker-Ramo Corp. This machine is used for inspecting printed circuit boards before they are installed in machine control units. The testing machine has a four-bank console which cycles through tests under the control of punched tape input. The console makes as many as 1,500 different tests on a printed circuit board in 15 minutes. The machine goes through its testing sequence until it discovers a failure, whereupon the operator activates a repeat switch to rerun the test. Repairs can be made at this time or testing can continue, with repairs to be made later. This system detects incorrect components, shorts and opens and wiring faults in seconds. It has available supplementary testing instruments for complete analysis of any fault discovered.[50]

SUMMARY

This paper presents a description of N/C operational devices. Operational devices identified and described under the classification of design and drafting include N/C drafting machines and N/C plotting machines. These machines are used for the preparation of drawings from mathematical descriptions; verification of tool and cutter path data on machine control input media; contour mapping; layout of printed circuit artwork masters and inspection templates; architectural drafting and automatic drafting of complex three-dimensional shapes.

Operational devices identified and described under the classification of production equipment include numerically controlled drilling, milling, boring, turning, grinding, punching and notching, tube bending, flame cutting, welding, filament winding, component insertion, wire processing and fabric cutting machines, as well as machining centers, routers and shapers. Miscellaneous production equipment applications include screwdrivers, riveting, shot-peening, and shearing machines. As the number of applications under the classification indicates, numerical control has been adopted extensively for use by production equipment.

Operational devices identified and described under the classification of inspection and testing include N/C inspection and N/C testing machines. These machines are a logical extension of N/C because they fulfill an increasing demand for improved accuracy,

speed and reliability in the inspection and testing of parts manufactured by N/C production equipment.

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Tools: The Industrial Arts Heritage

Leslie V. Hawkins

The question is frequently raised, "Why is mankind out of all God's creatures able to change, modify and glorify the world's resources for their use and enjoyment?" These resources can be converted into comfortable shelters, delicious foods and warm attractive garments.

While reflecting on the first question, three others come to mind. How did it begin? Where did it start? When did it start? Inasmuch as we are observing the 200th birthday of our nation, our attention should be focused on the United States. Many of the earlier influences affecting the growth and development of our nation apply alike to both the North American and South American civilizations.

It is believed that mankind's migration to America was by many routes and from many sources. The land bridge between Siberia and America is assumed to have brought the Asians to this country. The water route of both the Atlantic and Pacific Oceans brought Caucasians, Negroids and Polynesians to this vast land. Authorities cannot agree as to the exact date that mankind began to arrive, but it is thought to be roughly 40 to 60 thousand years ago. It is further thought that those who migrated over the land bridge route from Asia did not intend to migrate from one continent to another, but moved as a result of following herds for obtaining food, shelter and clothing.

The water routes from the Atlantic and Pacific Oceans are thought to have been direct migrations for the purpose of establishing new colonies. These people brought with them their tools, crude though they were by today's standards, and their technology. These tools were in the form of the stone axes, hide scrapers, arrowheads, bows and arrows and digging sticks. Because of their isolation, technology in the new world evolved slowly and spasmodically. The mystery of the growth of civilization is that two cultures were developing simultaneously on opposite sides of the earth under very similar conditions — one in the eastern end of the Mediterranean, the other around the rim of the Gulf of Mexico.

We are well aware of the inhabitants to which we refer as Indians who lived in America at the time the great migration from Europe began. Their tools were considered crude by European standards. The influx of Europeans to America brought tools, or the knowledge of tools and the latest technology. Industrial technology from all corners of the world was transplanted to America. However, there was not a ready supply of laborers to perform the necessary tasks of everyday living or even to make or create the accustomed necessities of life, such as beds, chairs and cooking utensils. The colonists were forced to use their ingenuity and develop the use of power sources other than human labor. They learned to utilize the power derived from water and animals, and later from steam.

The improved technology created the desire for an easier way of life. It affected a change in the philosophy of the craftsmen who began to specialize in a particular area. With this specialization came many new occupations. Many of the tools, such as hammers, saws, planes, augers and squares, are found with slight modification in the various occupations.

To obtain an insight into the technology that produced this great land, let's look at some of the more interesting industries which developed. First, examine transportation — both land and sea. It was vital that two different modes of transportation should be developed because of the fast distances, both on land and sea, from the mother countries. The coach maker or wagon maker was responsible for developing the wagons, drays, coaches, gigs and other wheeled modes of transportation that could be used, both on the farm and in town, for hauling passengers or freight. The conestoga wagon was designed and built by artisans of the Lancaster, Pennsylvania, region for hauling products to the eastern markets. As western markets opened, the demand for this wagon moved west. The conestoga was a large wagon which had to be drawn by six heavy horses and was one of the first wagons to be developed in America. The first ones appeared in about 1750. This wagon was capable of carrying 6,500 or more pounds a distance of 10 to 15 miles per day. As the country grew, St. Louis, Missouri, became the center of wagon production. Wagons and buggies played a major role in the lives of everyone from the cradle to the grave until the 1920's, when the motorized vehicle became economically feasible.

Wheelwright

The wagon maker needed someone skilled in both woodworking and blacksmithing to assist in the production of the wheels. Thus a specialist — the wheelwright — evolved. Wheelwrights first produced a barrel-shaped hub of the toughest wood available. Swamp white oak and osage orange (Bois d'arc) were the two most desirable woods. The hub was lined with a cast iron sleeve to increase wearing ability. Each hub contained rectangular holes for 12 to 16 spokes, depending upon the strength required of the wheel. The outer ends of the spokes were secured with a wooden rim banded with an iron hoop. These wheels could support massive loads and take terrific shock if the vehicle had to move at a rapid speed over rough terrain.

Cooper

This craftsman was commonly referred to as a barrel maker. They produced the containers which were necessary for shipping materials of all types over land or oceans. In addition to the containers, these individuals produced tubs, pails, washtubs, kegs, hogsheads for liquids and piggins (used for water troughs or tanks). These utensils were used in the everyday activities of the farmer, manufacturer and merchant.

Shipwright

In the towns and villages of the eastern seaboard, the shipwright was a prominent individual in the community. These craftsmen were responsible for building ships. One of America's greatest resources was the trees which provided the timber for making the

frames and planking of the wooden ships. The ship yards were little more than slips (protected inlets) where wooden frames could be erected to be used as cradles to hold the wooden members or ribs in position until the ships were completed and secured. This was an exacting occupation because of the forces exerted on the curves, joints and stress points of the ships during storms at sea.

The ship builders were assisted by an array of jointers, carpenters, riggers, blacksmiths and other craftsmen. It required almost as long to rig a ship — that is, to put up the mast, the ropes and the sails — as it did to build the hull. Rigging a ship required enormous quantities of rope, which in many cases had to be twisted by hand from small twine to form the required size, strength and length.

Sailmaker

The sailmaker produced the sails for the ships from canvas which was woven from coarse flax fibers known as "tow," a fiber not used in the linen making process. The sails were assembled in lofts which were little more than a huge room where the cloth could be laid flat on the floor. Sails were made of strips of material sewn together by hand. Great skill was required in cutting the cloth so that the sail would cup just the right amount to catch a slight breeze. The principle tools of the sailmaker were the shears, a four-inch needle and strong twine. Sailmakers wore a copper-studded rubber palm to protect the hand from the pressure used in forcing the needle through the cloth. Cording the ropes into the sail made sailmaking a difficult task.

Blacksmith

No discussion would be complete if we overlooked the activity of the blacksmith. This occupation was the mainstay and the center of activity for small towns and villages. Two requirements for this trade were a forge in which to burn wood or coal, and hide or leather covered bellows to create the high temperatures necessary for heating the iron. The principle tools of this craftsman were the anvil, the sledge, the hardie, thongs and an apron to protect the clothing. The primary products were hoes, plowshares, cowbells, axes, horseshoes, nails, door hinges, latches, bolts, shutter hooks, handrails, footscrapers, tongs, pokers, gates and weathervanes. In addition, they produced many cooking utensils that were used in the homes, such as forks, pot hooks, dippers, strainers, trivets, boilers, toasters and handles.

Coppersmith

The craft of the coppersmith is thought to have been one of the more prestigious occupations. The coppersmith used many of the same tools, with some modifications, as the blacksmith. Copper was mined in Connecticut, Pennsylvania and New Jersey. At the smelters the copper was cast, then beaten into thin sheets for commercial use. The coppersmiths shaped this material into kettles, stills, boilers, measures, pails, pots, pans, tankards, funnels, tea kettles and other household items used in upper- and middle-class homes.

Gunsmith

Our discussion of occupations of the early citizens of this nation would not be complete without a consideration of the role of the gunsmith. He contributed the firearms needed on the frontier. His tools were similar to those of the blacksmith, with the exception of a few specialized ones for reaming, boring and broaching the rifles. Most of the colonial gunsmiths made or repaired flintlocks, muskets, and smooth-bored muzzle loaders. Two rifles that were developed in this country which became quite popular were the Kentucky and Pennsylvania long rifles. Only a few hand guns were made in the colonies. Most of these were imported from Europe.

Silversmith

The silversmith was the elite craftsman of the smithing occupations. Most of the wealth of the early colonists was in the form of silver, which was frequently used as currency. The silversmith was the banker, the assayer and the engraver. It was not uncommon for the affluent colonists to request that silver coins be made into personal items which were much easier to identify in the event of theft.

The silversmith used many of the same tools as the coppersmith. Skills were required in casting, soldering and hammering. The silversmiths produced such articles as

flatware for the table, tankards, teapots, plates, buttons, pitchers, candle holders and bowls. If it was a major item, frequently it was engraved with the initials of the owner to assist in identification. In addition, it was not uncommon for the silversmith to sign the article with a touchmark to identify the manufacturer of the article.

Housewrights or Carpenters

This trade became more prominent as families became more affluent and began to fulfill their ambition to move from log cabins into houses. These craftsmen received the hewn logs and made them into timber and lumber with which to construct the house. The principle tools were the chalk line, the felling axe, the broad axe, crosscut saws, drawing knives, augers, mallets, claw hammers, shingle horses, squares and levels. Because of its abundance, most of the early houses in this country were made of wood; however, some were made with stone or brick for the walls. The roofs usually were made of wood or thatch.

Jointer

The jointer performed the finish carpentry for homes or businesses. Their tools consisted of various sizes of planes, wooden braces, vices, lathes and marking gauges. They smoothed the rough, coarse lumber so that it could be used in the interior of the buildings for window frames, stairways, banisters, chests of drawers, panels and lidded boxes.

Cabinetmaker

These were the highly skilled jointers, and these colonists produced some of the finest furniture ever made in America. The most common woods used at this time were the pine and chestnut in the North, and in the South it was magnolia. These woods were plentiful, and articles produced from them were usually quite economical. More expensive furniture was made from maple, walnut, cherry and Honduras mahogany. These articles often were adorned with iron, brass, or copper. The more popular articles produced by the cabinetmaker were chairs, chests, tables and sideboards. Many of the articles produced in colonial times are highly prized as works of art.

We have only touched on a few of the occupations or trades pursued by early colonists. However, we should mention a few others, such as the brickmaker, who produced the bricks for the foundations, fireplaces, streets and sidewalks; the chandler, an individual skilled in the production of fine candles and scented soaps; and the tinker, an independent businessman who traveled throughout the country with his tool box (the "pig") and repaired wooden or metal objects in the homes for the country people. The arrival of the tinker was eagerly awaited by isolated families, inasmuch as he was their chief contact with the outside world and he brought them news of what was happening. Today we might compare this craftsman with a roving newspaper or television reporter. Other craftsmen worthy of mentioning are the miller tobacco cutter, tanner, hatter, cobbler or shoemaker, and the tailor.

Tools are the technological jewels that created the machines which developed our present-day lifestyle. Through machines we are able to expand our talents, our abilities or skills and our production potentials. We in the twentieth century depend upon the machine for the production of better and more economical clothing, food and shelter.

As our present energy sources are consumed and/or depleted, it will become necessary for us to seek others to supply the increasing number of diverse industries. This should not be observed as an insurmountable problem, but as a golden opportunity to exercise the ingenuity for which Americans are known. Industrial arts teachers should be proud of this rich heritage and make every effort to make it known to the youth of this nation and encourage them to strive for even greater technological accomplishments.

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Tools of the Past—An American Heritage

Everett Sheffield

Hand tools have helped make man's civilization, evolution and development possible. In order to change the natural resources around him into the rudiments of life which are food, clothing and shelter, man had to possess and use tools. The importance of knowledge about tools in the development of human civilization cannot be overlookes; tools were important to past civilizations, and they are important in continuing and maintaining society as it now exists. The importance of the knowledge of tool use in today's society is well illustrated by the technological advancements that have come about in the twentieth century.

In America our first century began in turmoil, with only a small part of the nation settled. Manufacturing, travel and building utilized hand or animal power. Food, clothing and shelter were a major concern of everyone. That first century experienced the full impact of the industrial revolution. Manufacturing and technology developed, and America was settled extensively. By the end of that first century we were ready for the great centennial technological exhibition in Philadelphia. At that exhibition the mounting marvels of American ingenuity were put on display before the world. The exhibition exemplified a sense of American boldness and adventure. There was a national conviction that we were capable of doing great and expanded things.

Industrial arts had its beginning at that exposition. Educational leaders in America saw examples of European training techniques that spurred them on to develop techniques much the same as we find in today's industrial arts. This year, 1976, is not only the bicentennial of our nation but the centennial year of industrial arts.

The second century of our nation bore out that national conviction of boldness and adventure. Our nation's settlement was completed; we built industrial and agricultural economies; and we became a world power and a global economic force without precedent.

During the first century of our nation's development, hand tools played an important role in everyday life, as well as making the full impact of the industrial revolution possible. The second century saw the west settled and full industrial development completed. Hand tools were indispensible in making all of this possible; it could not have happened without those tools and the craftsmen who knew how to use them.

Much of America can be seen in our tools of the past. For purposes of study, all tools can be grouped into six process groups: Abrading, cutting, drilling and boring, holding, measuring and striking.

ABRADING

Abrading tools include rubbing stones, grind stones, bronze files, iron files and today's modern files of various shapes. Crude naturally occurring stones were used as the first

abrading tools until the discovery of metal provided a division in the development. Files became one branch of development, and grinding stones developed as the other branch.

The abrading process is defined as follows: "To wear down by rubbing, scrape off." (World Book Encyclopedia Dictionary) Abrasion tools, as with most other tools, probably started with man picking up bits of stone, bone, wood, shell or other handy material to do a job. Sticks were probably rubbed with a rough stone surface to crudely shape them.

The Bronze Age provided a new material from which to construct tools. During this age, files much as we know them today appeared; however, the use of bronze files was confined to the working of wood due to the relative softness of the metal.

When the use of iron became popular, files acquired a new meaning, for harder materials including iron itself could be shaped. During the Roman period of the Iron Age, files became common. The craftsman of the Roman period used files of many sizes and shapes; this is indicated by many finds and excavations now on exhibit in museums.

The making of files was a hand process until the nineteenth century. The blanks had to be hammered to shape by hand. The teeth of the file had to be cut individually by hand with the use of a hammer and chisel. The state of the art must have remained much the same for many hundreds of years after the Roman Empire.

The next step in the development of the file is machine manufacturing, where the file blank or the chisel is moved automatically. Examples of early machine-made files can be observed in early trade catalogs.

Modern files could be classed readily as cutting tools because they are very efficient compared to their predecessors.

CUTTING

The industrial arts hand tools included in this process group have a common physical characteristic, a single blade or edge prepared for the purpose of cutting. Since the purpose of all of the tools in this group is to cut, Webster's definition of cutting may give a more detailed description of their function: "To sever, gash, incise, divide into parts, etc., with or as with an edged instrument; as, to cut bread." The process of cutting or dividing into parts with an edged instrument has been used for hundreds of thousands of years.

The first cutting tools were no doubt just sharp bits of naturally fractured stone, but as the Paleolithic period in the development of mankind drew to a close, the number of cutting tools had been increased to several more sophisticated stone tools including the knife, saw, axe, adz, burin (chisel) and scraper.

Drawknife

The earliest example of the drawknife is a Roman tool illustrated by Aldred. Another example is on exhibit in the Statents Historike Museet, Stockholm, as part of a set of shipbuilders tools dated to 950-1000 A.D. Moxon pictures a drawknife among his carpenter tools.

Spokeshave

The modern metal spokeshave was popularized in America in the mmddle of the nineteenth century.

Planes

A widely used tool that functions much as the drawknife, spokeshave, and scraper is the plane. The first plane was possibly a chisel-like tool inserted in a block of wood. The earliest known planes were found in Pompeii and date from 79 A.D.

Planes remained much the same for centuries, but with the dawning of the Industrial Revolution in the latter half of the eighteenth century, the next logical step to take was factory production of the plane. About the time that the plane was well into the Industrial Revolution (shortly before 1800) a change was made that affected all bench planes. This was the introduction of the double iron to aid in the breaking of chips.

Another improvement which brought the plane close to today's in physical structure was the patenting, by H. Knowles, of the all-metal plane. This patent was issued in 1827, but all-metal planes were not popular until the latter part of the nineteenth century.

The next development which gave the plane fine adjustability was Baley's patent of 1867. A knob that moved the blade up and down was the basis of this improvement. Metal

parts were included in the adjustment mechanism, but the base of Baley's plane was still wood.

The development of the hand plane reached its highest level near the end of the nineteenth century; machines were commonly doing much of the hand work by that time.

Chisels

The chisel, like many of the hand tools now used in industrial arts programs, originated in the Stone Age. Examples of Stone Age chisels called burins are a type of blade tool which was well established 40,000 years ago.

Chisels of the Ground Stone Age (Neolithic Stage) have an appearance similar to gouges currently used in industrial arts laboratories, except for the handles.

As the Bronze Age progressed and the process of casting was improved, variation was possible in the manufacture of chisels. Tang chisels and socket chisels now used in industrial arts programs had their origins as bronze tools.

The earliest use of iron from which to make chisels has been traced to a hoard of Assyrian tools found by Petrie at Thebes, Egypt, that date to the eighth century B.C. As with other tools, the Romans developed chisels to quite a high degree. There is very little to say about the development of the chisel between the Roman period and the time of Moxon. A comparison between Roman chisels and those shown by Moxon in Mechanik Exercises makes this quite evident. There appears to be little improvement in chisels from 1877 to the present, as is typical of most hand tools now in use.

Saws

The exact origin of the saw seems to be surrounded by controversy. Three writers refer to flint saws, and one writer (Goodman) contends that "flint saws" were not really saws at all.

The dawning of the Bronze Age brought an introduction of metal saws along with the other metal tools that have already been mentioned. Metal saws are dated to as early as 2,000 B.C.

Iron saws date from 600 B.C. These early iron tools were Assyrian saws found at Thebes and are of the pull type which were much like their bronze predecessors. The Romans developed the saw quite extensively, just as they invented and improved many other tools.

The saws of the Romans consisted of small knife-like saws, small frame saws, larger frame saws for sawing lumber into boards, and small-backed saws. The Industrial Revolution appears to be the changing force that aided widespread production of saws and other tools.

DRILLING AND BORING

The exact origin of drilling and boring tools is hidden in the Stone Age, but it is known that the blade tool industries of 40,000 years ago contained drills or awls.

The pump drill, said to be devised by Stone Age man, has continued in use to the present century and is also in use by sculptors and those specializing in repair of china.

Another drilling and boring tool that was devised many centuries ago is the auger bit. The auger was not known before the Roman period. The auger of the Roman period was not a spiral auger as is used in today's industrial arts shop, but it was a pod auger. Credit for invention of the spiral auger is given to Ezra L'Hommedieu in 1809.

HOLDING

The first obvious holding device used by man is the hand, which of course is not a tool. It would also be difficult to classify cord or leather thongs as tools, although it is almost certain that wrapping and tying was used quite extensively by Stone Age man. A Stone Age application of wet hide for the purpose of mending broken articles is discussed and illustrated in the 1894 Smithsonian Report.

Holding takes the form of two types. The first is the use of C-clamps and hand screw clamps for temporarily fixing two or more pieces of material in place during assembly. The second type of holding is accomplished by using a screwdriver, a wrench, or the pliers to hold screws, bolts, nuts, and other fasteners for increased leverage while installing or loosening them.

C-Clamp

The development of the prototype of the modern C-clamp was dependent upon the development of the screw, which was well known in antiquity but was not applied to tools. This limited application retarded the development of the C-clamp, that used the screw, to a much more recent time in history. A common forerunner of the modern C-clamp is proposed by Goodman to be the holdfast, dating from its application on the Roman bench.

The increasing availability of efficient machinery for screw production apparently led to the development of a device referred to by Knight as a screw-clamp which is, in essence, a C-clamp. One variation offered in the catalog inscribed with a patent date of 1872 is called the "Hammer and Co.'s adjustable clamp."

Hand Screw Clamp

Clamps with wooden screws and the appearance of the modern hand screw clamp were offered for sale in 1877. The screws of the early all-wood clamp are standard right hand cut the entire length of both screws, which would indicate that the clamps were not quick adjusting as is the modern clamp found in industrial arts shops. Hand screw clamps with steel screws were offered in 1896, along with clamps having wooden screws, at about five cents per clamp higher.

MEASURING

The process of determining specific dimension, capacity or size of an object or material is measuring. The system of measurement was almost certain to have begun with man making standardized tools and crude dwellings. There is conjecture that earliest measurement are those that were derived from the limbs of man. This conjecture is known to have been applied in ancient Egypt beginning about 3000 B.C. The unit of measure developed and standardized at this time was called the cubit and was the length of man's forearm from the point of the elbow to the tip of the middle finger of the hand.

Rules

The major industrial arts measuring tools — the folding (zig-zag) rule, push-pull rule and circumference rule — have, in general, made their appearance during much more recent periods of time than many other tools of the industrial arts shop. The folding rule and push-pull rule are made collapsible in an attempt to provide compactness and yet cover several feet when measuring. A very early attempt at providing compactness dates from 1400 B.C. The use of a knotted rope is shown in a wall painting at the ancient Egyptian Abd el Qurna, finely reproduced on the cover of the booklet Man and Measure by Matthews.

Definite examples of folding rules from the Roman period are on exhibit at the London Museum at Kensington Place, the National Museum of Whales, and also at Cardiff, Lyons, Zurich and Naples. These early Roman tools were of bronze, usually one foot long and hinged in the middle. The use of the folding rule may have been lost during this period due to what are called straight edges. An example of a bronze folding yard rule, hinged in the middle and carrying a date of 1634, is illustrated in Man and Measure.

Mass production of the four-fold boxwood brass-bound two foot rule was begun about 1840. The four-fold rule was quite popular during the latter part of the nineteenth century; many variations and styles are available in old tool and hardware catalogs.

The four-fold rule does not remain a popular type of folding industrial arts measuring tool, but has given way to the zig-zag rule. The origin of the zig-zag rule is referred to by Wyatt in the following quote: The zigzag rule, in Figure 84B, was first made in this country by the Stanley Company in 1899."

A rule even more compact is the push-pull rule; it is also a major industrial arts hand tool.

Squares

Another group of tools that are considered to be of major importance in industrial arts are the squares. The origin of the try square for trying or inspecting and guiding is certain to have begun as early as 1490 B.C. with the ancient Egyptians. Knight has illustrated a wall inscription from Thebes that includes a square that roughly resembles the outline of the modern try square. The general quality of ancient Egyptian architecture and crafts would have practically demanded some sort of squaring device.

The Roman use of squaring devices resembling the try square is evident when examples are observed.

Squares of the Roman type were in use throughout the Middle Ages, but they varied somewhat in detail because they were usually made by the craftsman themselves.

STRIKING

It does not tax the imagination unduly to think of striking tools as being the first tools used by man. The first striking tool could have been a stick, stone or bone used for unknown tasks.

Definite dating of the hammerstone to earlier than 500,000 years ago does indicate that striking implements were among the first tools used by man. The universal nature and simplicity of striking tools added greatly to their widespread use.

The use of ground stone hammers did not end with the advent of the Bronze Age, evidently because the weight and hardness necessary for most hammer applications could not easily be achieved by this metal.

The use of iron for hammers was evidently more popular because of the greater hardness of the metal. Petrie illustrates an iron hammer dating from the fifth century B.C. that was found during his years of digging in Egypt. He refers to this tool as being produced by Greeks who were camped in Egypt.

Claw Hammer

The use of iron for hammer heads was continued during the development of Roman civilization, since examples of Roman hammers have been found. The Romans also appear to have developed the iron claw hammer, which is one of the major industrial arts hand tools for striking.

The earliest claw hammers appear to have been quite short in the length of the eye, which would have created problems with loose and broken handles. This problem was remedied partially in Medieval Europe by extending the iron of the hammer head back on both sides of the handle and riveting the handle between these two extensions, thereby strengthening the weak part of the handle.

Later development of the claw hammer includes improvements of steel alloys and the use of hollow steel and fiberglass for hammer handles. The use of the improved steels and steel and fiberglass handles makes the modern claw hammer found in today's industrial arts shops almost indestructible.

CONCLUSION

Historical tool development seems to be a neglected part of the industrial arts curriculum.

Tool development and standardization played an important role in the advanced development of mankind. The concept of standardization originated during the Stone Age when man began to make tools almost exactly alike each time. When man was able to standardize tools, he had a preconception of how the tools were to be used.

The discovery of bronze and the Bronze Age resulted in modern-appearing tools. Iron and the Iron Age resulted in some tools that were complete in development and modern in function.

The Industrial Revolution created conditions for a vast change in some tools and also created a need for the invention of others. Many of the current tools that had their origin during or after the Industrial Revolution were complete in development, with little or no additional change required.

TOOL COLLECTING

Many people are collecting old hand tools today. Some people find history in tools; others find beauty and still others find enjoyment in using some of them.

With increased interest in this activity, the cost for the product is certain to increase. Antique shops, garage sales and auction sales are typical sources for the amateur or serious collector.

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Women in I.A.

Industrial Arts and Nontraditional Occupations for Women

Herbert A. Anderson

Last fall a friend and personnel manager of a moderately large firm came to our campus to recruit graduates in the general area of industrial management. He had interviews with several men, but no women. At lunch he joshingly threatened me by saying he would not be on campus again until I promised him a female black industrial management graduate. My friend kept repeating, "I've got to fill some affirmative action goals."

This is not a talk on affirmative action nor equal rights legislation, although that piece of legislation has had its impact upon education and meeting societal needs. I hope to focus a few remarks on how industrial arts can help fulfill these needs.

A few weeks after my friend from industry had challenged me to enroll some women in our programs, I had lunch with an industrial arts department chairperson from a nearby

high school. He indicated that his classes were attracting more girls this year compared to previous years. A third of his drawing students were girls, and there were several in electronics. After lunch we went back to my office, and I showed him a table of census data which was generated by the Wisconsin Department of Public Instruction. If the figures are correct, and I have no reason to dispute them, it would indicate that today there are only half as many 1 year olds as there are 12 year olds. Translate that to school populations and, more specifically, enrollment potential for industrial arts. If only boys are encouraged to enroll, you may be looking for another job! What is the answer?

NEW POPULATION BASE

On the surface it may appear that we are only concerned with our own employment and the future of industrial arts. This may be partially true, but more important to our society is the potential industrial arts has to increasing the nation's human resources. If we can attract girls to industrial arts, we will double the population base from which we draw students. Carried a bit further, our nation's human resources may not double, but it has the potential of a significant increase.

There is little doubt that women can perform as well as men in most jobs wherein sheer muscle power is not a factor. The January 5, 1976, issue of Time Magazine devotes its lead article to describing women's success in many occupations: "Braniff Airways Flight Engineer Sandra Simmons..., Telephone Lineperson Janis Stark..., Locomotive Engineer Evelyn Newell..., New York All-Women's Line Firm, etc...., Unionist Addie Wyatt, Woman's Affairs Director of the 550,000-member Meat Cutters and Butcher Workman Union, summarizes their concern when she stated, 'All we're asking is that we be recognized as full partners — at home, at work and in the world at large. Is that too much?'"

The fear voiced in some quarters that the labor force will become too large and result in unemployment is offset by generating a more competent labor force because of competition. Furthermore, talent heretofore undeveloped will be utilized to increase our productivity and help solve many of the problems now confronting our society.

What can be done to encourage women to consider non-traditional careers?

ATTRACTING WOMEN TO INDUSTRIAL ARTS

Begin by recruiting women to prepare for an industrial arts teaching career. If we are partially successful in this endeavor, secondary school girls will feel comfortable enrolling in industrial education subjects. At UW-Stout we are trying to obtain funding for stipends to encourage more women to prepare for teaching industrial arts. Generally, boys decide to become industrial arts teachers because their interest was sparked by taking industrial arts courses in the secondary school. Girls may do the same if given the opportunity. It follows that classes must be open to them, which it appears is not the case in some schools. This in itself is a form of discrimination.

ATTITUDE TOWARD WOMEN ENGAGED IN NON-TRADITIONAL OCCUPATIONS

Our society permits and encourages boys to follow one course of events while girls follow another. Pre-school children are introduced to it, since mothers in most families are home caring for them and fathers go to work. Toys tend to discriminate, as do clothing.

Books are authored in a biased manner, as noted by Ms. Marcia Harycki,[1] an industrial education student at UW-Stout. For an assignment in a curriculum innovation course, she examined and rewrote two paragraphs in the World of Manufacturing text. They are quoted as follows:

> Male domination as printed:
>
> Every kind of life that has survived has had some special ability that has helped it to survive. For man, one special quality has been his ability to reason (to think logically, to make judgments). Physically, man is no match for many kinds of animals, and he is not well protected by nature from the extreme changes in weather. But his ability to reason has led him to invent shelters, clothing and other ways to protect and feed himself.

Man has another ability which has helped him survive. This is his ability to speak, to use language. By using language, man is able to express ideas and to make them known to his fellowman. In this way, individuals and groups of men are able to take advantage of new ideas and to profit by the successes and the mistakes of others.

Female domination as revised:

Every kind of life that has survived has had some special ability that has helped it to survive. For woman, one special quality has been her ability to reason (to think logically, to make judgments). Physically, woman is no match for many kinds of animals, and she is not well protected by nature from the extreme changes in weather. But her ability to reason has led her to invent shelters, clothing and other ways to protect and feed herself.

Woman has another ability which has helped her survive. This is her ability to speak, to use language. By using language, woman is able to express ideas and to make them known to her fellowwoman. In this way, individuals and groups of women are able to take advantage of new ideas and to profit by the successes and the mistakes of others.

Unbiased as revised:

Every kind of life that has survived has had some special ability that has helped it to survive. For people, one special quality has been our ability to reason (to think logically, to make judgments). Physically, we are no match for many kinds of animals, and we are not well protected by nature from the extreme changes in weather. But our ability to reason has led us to invent shelters, clothing and other ways to protect and feed ourselves.

We have another ability which has helped us survive. This is our ability to speak, to use language. By using language, we are able to express ideas and to make them known to each other. In this way, individuals and groups are able to take advantage of new ideas and to profit by the successes and mistakes of each other.

In her report, Ms. Harycki makes the following comment about the revisions:

> Although the first version is the most common to many ears, I hoped to show how strange it sounds to me by writing the second version for contrast. We ask girls to involve themselves in a "man's" world, yet we don't include them in its language. It is as if we say one thing and do another. We want women in technology, yet we resist it. Granted we don't have a mental image of females as active, competent electricians or mechanics or industrial leaders, but why not use language which encourages their participation instead of language which talks only about the "world of man"? Why very subtly reinforce an old destructive custom when we could be encouraging new growth for both boys and girls?

Once the coed finds herself in the power laboratory, how do the male students react? Several interviewed indicated that once she proves she can perform as well as or better than the male peers, she is accepted; the male instructor can present more problems, since he has not internalized the need for changing his approach to working with a class of both sexes. This is especially true as the first two or three coeds enroll for a class. Unknowingly he may focus attention upon them with casual remarks such as, "Now that we have some girls in class, watch your language;" or he may tell a joke which focuses on women. He may give the coeds extra help, which tends to identify them and thereby embarrass them. Most of our male industrial education teachers who have not had coeds enrolled in their classes will be vulnerable to destroying the climate which would encourage females to enter non-traditional areas.

Few school counselors have made the transition to consider girls for training to fill positions formerly dominated by men.

Throughout the entire nation in 1972-73, 8,543 students received baccalaureate degrees with majors in industrial arts, vocational and technical education; 228 were awarded to women. This indicates that less than three percent of the teachers in these fields who are available for employment in secondary schools are women. In 1970-71, only 1.5 percent of the total degrees in these majors were awarded to women. By percent there has been growth, but the number is still remarkably small.[2]

University freshmen women report that the one person who had the most influence on goals and aspirations as a role model were first, mother, second, a woman teacher. Outstanding professional women in the community also ranked high.[3]

WOMEN AND WORK: MYTHS AND FACT

Several reasons have been offered to explain women's general failure to advance into more responsible, better paid jobs, despite the fact that they constitute 38 percent of the labor force. On closer examination, many of these explanations turn out to be more myth than fact.

"Women are intellectually unsuited for professional work."
Studies show that two thirds as many females as males among 11th grade students tested have engineering aptitude. Women's lack of professional and technical training does not follow from a deficit in potential ability, but rather from education, counseling and the general socialization processes that direct women away from such careers.

"Women are physically unsuited for many jobs."
Specific aptitudes, including finger dexterity and hand-eye coordination, required for a number of crafts, are found as frequently among female as male students. As to weight-lifting ability, men on the average are stronger than women, but clearly there is some overlapping, with some women being stronger than some men. (The Equal Employment Opportunity Commission is taking an increasingly critical look at any claim of sex as a "bona fide occupational qualification.")

"Women are emotionally unsuited for executive work."
Even professional opinion is divided on this point, but doctors point out that men as well as women have physical/emotional problems which interfere with their work. They assert that it is not the case that all women have difficulty performing work during menstrual periods or menopause. Studies by Dr. Estelle Ramey of Georgetown Medical School have proved repeatedly that women stand up to stress, on the average, better than men do.

"Women don't have to support families."
Most women do, in fact, work to support themselves or others. Ninetten percent of working women are widowed, separated or divorced; 22 percent are single; and 25 percent have husbands with annual incomes below $7,000.

"Women have a higher rate of absenteeism."
Two major studies show there is a very little over-all difference between men and women in this regard. In one study, the annual time lost due to illness or injury was 5.6 days for women, 5.3 days for men; in the other, it was 5.3 days for women, 5.4 days for men.

"Women aren't seriously attached to their jobs."
Over-all turnover rates are indeed higher for women because they are disproportionately represented in lower occupations, where turnover is highest for both sexes. When compared with men in similar occupations, however, women's turnover rates are only marginally different. In terms of occupational mobility, men change jobs more frequently than women (10 percent vs. 7 percent). Women's work life expectancy is, on average, only 25 years compared with 43 years for men. However, between 1900 and 1960 it more than tripled (from 6.3 years to 20.1 years), and it is still increasing rapidly.

Clearly there is evidence that tends to overthrow or seriously modify many of these preconceptions. One must conclude, therefore, that the real reasons for the failure of qualified women to advance more on an equal footing with men are to be sought in cultural biases and structural discrimination in employment.

SUMMARY

This paper was not meant to focus on equal rights issues, but of necessity it had to describe conditions as they exist concerning equal rights for women. Women can significantly increase human resources in this nation if given opportunities for training and society's acceptance.

A new population base is provided by women for industrial arts, but the rate at which we attract girls to industrial arts is almost in direct proportion to the number of women who can be attracted to teaching industrial arts.

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Association Business

Minutes of the Representative National Assembly Business Meeting

Donald L. Rathbun

April 23, 1976, Des Moines, Iowa

President Alvin Rudisill called the meeting to order at 9:15 a.m. He introduced the parliamentarian, Jon Ericson of Drake University. Roger Betts, chairman of the Credentials Committee, reported that all of the delegates or alternates had been checked and certified as official and could be seated.

Donald Rathbun, executive director, asked for approval of the delegates' minutes from the 1975 Cincinnati conference as distributed in the packet.
Laura Lewis, New Jersey, so moved.
William Scarborough, North Carolina, seconded.

Motion passed.

The treasurer's report, as included in the packet, was reviewed. Frank Ingram, Michigan, moved that the report be accepted as presented.
Charles Earhart, Ohio, seconded.

Motion passed.

Kenneth Schank, New York, asked if a life member survey had been done to determine the cost of servicing these members. Donald Rathbun replied that such a survey was in progress and a report would be published in M/S/T during the next school year.

Frank Ingram asked why expenses in AIASA and AIACSA accounts exceed income. Mr. Rathbun explained that salary, as well as other expenses, is pro rated in individual accounts, i.e., the coordinator of professional services is responsible for the student clubs and a large percentage of his time is spent dealing with student activities; therefore, a corresponding percentage of his salary is pro rated or charged off as AIASA expense or overhead.

Carl York, Illinois, commended both the president and the executive director for the clarity and the comprehensiveness of the treasurer's report.

The membership report, as included in the packet, was reviewed by Donald Rathbun. He pointed out that between March 1975 and March 1976 there had been a 31.7 percent increase in regular membership. Edward Kenyon, Florida, moved to accept the membership report as presented. He also complimented the national office, the executive director and the Membership Committee for their efforts and contributions that produced this increase.
William Scarborough seconded.

Motion passed.

Alvin Rudisill referred to the president's report in the packet and presented a brief overview. Lee Carter, president-elect, was then called upon to review his goals for the coming year. They are:

1. Continue to emphasize membership as the number one priority.
2. Encourage support of the student organizations.
3. Continue to promote and encourage committee activities under the dynamic leadership of the chairpersons.
4. Establish a National Advisory Council for Industrial Arts involving teachers, teacher educators and industry.
5. Establish a nationwide talent bank using stalwarts of the Association, past officers and retirees as consultants.

6. Establish closer working relationships with other national associations and industry.
7. Improve communications between the Association and state associations. Use of the Committeegram is an example.
8. Reinstitute an educational packet service for teachers and provide increased teacher services.

Thomas La Clair, New York, moved to accept the president's report.
Laura Lewis seconded. Motion passed.

The revised House of Delegates Policies and Procedures Manual, as included in the packet, was called to the attention of the delegates with a request that they read it thoroughly.

The resolutions were brought before the House. The parliamentarian offered a friendly reminder that once a resolution is placed on the floor, it belongs to the House and may be amended.

Donald Hackett, past president, moved the adoption of Acknowledgment Resolutions A-76-1 through A-76-13. (Appendix A)
Robert Thrower, New Jersey, seconded. Motion passed.

Donald Hackett moved the adoption of Standing Resolutions S-76-1 through S-76-9. (Appendix B)
Charles Benshettler, Pennsylvania, seconded. Motion passed.

Donald Hackett read the following Current Resolutions. (Appendix C) He moved the adoption of C-76-1.
Dennis Dirksen, California, seconded. Motion passed.

Donald Hackett moved the adoption of C-76-2.
Russell L. Keeton, South Dakota, seconded. Motion passed.

Donald Hackett moved the adoption of C-76-3.
Robert Duren, Wisconsin, seconded. Motion passed.

Laura Lewis made a friendly revision to change the word "meeting" to "conference" throughout the resolution. Revision approved.

C-76-4 was read. Frank Ingram asked who determined the amount of money spent for the annual conference. Alvin Rudisill replied that the Executive Board did so. Carl York further clarified this by saying that the money which is appropriated is given to the local Planning Committee which is responsible for the wise use of the funds. Robert Thrower stated that he had participated in a former conference and appreciates the need for money; however, he favored defeat of the resolution and referral of further discussion of the amount to the Executive Board. Glen Fuglsby, Washington, stated that he wished the resolution to be defeated. John Gallincili, New Jersey, stated that there is a need for a funding formula based on anticipated income. He suggested that past participants of Conferences draw up a formula. Vincent Kutemeyer, Louisiana, agreed with the need to plan ahead, but stressed that there was no time to negotiate C-76-4 since the time element for New Orleans was too short. Frank Ingram remarked that because 14,000 dollars is anticipated as income for the Planning Committee, it does not necessarily follow that it will be needed or spent.
A roll call was requested: aye, 35; nay, 49. Motion defeated.

C-76-5 was read. James Good, New York, opposed the resolution because:
1. The Executive Board has not said an increase is necessary.
2. The Association is in the black for the first time in a long time.
3. The Association needs numbers and increasing the dues would discourage members and/or prospective members. Allen Bame, Virginia, author of the resolution, said that the intent of the resolution was only for the Executive Board to consider the possible need and practicality of the dues increase.

Louis Pardini, Arizona, moved that C-76-5 be accepted.
Edward Kenyon seconded. Motion defeated.

C-76-6 was read. The consensus among the delegates was that since many of the business items presented to the House of Delegates are not known until shortly before the meeting, it is impossible to inform state associations of the agenda one month prior to the delegates' meeting.
Donald Hackett moved the adoption of the resolution.
William Scarborough seconded. Motion defeated.

C-76-7 was read. Discussion of this resolution centered around the fact that the cost of servicing cimplimentary memberships would be excessive and the Association is not in the position to assume that liability. Donald Rathbun reminded the delegates that students already have a 50 percent reduction in dues. Thomas LaClair suggested that the Executive Board take the resolution under consideration.
Donald Hackett moved the adoption of C-76-7.
Thomas Baldwin, Wisconsin, seconded. Motion defeated.

C-76-8 was read. Alvin Rudisill stated that since the resolution was not received 24 hours prior to the House of Delegates meeting as required by the constitution, C-76-8 could not be considered. William Skelly, Pennsylvania, stated that it was submitted 24 hours in advance. Alvin Rudisill said that it was the decision of the chair not to consider the resolution and to put the question to a vote. The chair was overruled. William Skelly read several editorial changes. James Mooney, New York, said that the Association is at a crossroads, and after 40 years it needs to reassess the Association's relationship to 60,000 teachers. He suggested an indepth study (2 to 3 years) at an estimated cost of 2,000 to 3,000 dollars. Charles Earhart said that the newly published booklet Industrial Arts: A Means of Preparing Youth to Understand and Contribute to Our Industrial-Technological Society, is an appropriate vehicle to describe the Association's intent.
Donald Hackett moved adoption of the resolution.
Charles Heyl, Massachusetts, seconded. Motion defeated.

Alvin Rudisill called for old business. There was none.

He then called for new business. Donald Rathbun told the delegates that NEA had accepted AIAA's application for nongovernance affiliation and the House was required to ratify the affiliation. (Appendix D) Laura Lewis moved that the House of Delegates ratify the affiliation.
William King, Ohio, seconded. Motion passed.

Vincent Kutemeyer presented the concept paper of the New Orleans 1977 Conference Planning Committee. (Appendix E) He moved it be endorsed as presented to the delegates on April 21, 1976.
Carl York seconded. Motion passed.

Patterson Fairchild, New Mexico, moved that in order to eliminate confusion at the seating of delegates, the membership count to determine the number of eligible delegates should be taken from the state where a member is employed and not from the state where he resides.
Russell Keeton, South Dakota, seconded. Motion passed.

Thurman Stone, Missouri, moved acceptance of the Governor of Missouri's proclamation to proclaim April 19 through 23, 1976, as Industrial Arts Education Week in Missouri. (Appendix F)
Dennis Dirksen seconded. Motion passed.

The meeting adjourned at 11:10 a.m.

Resolutions of the Representative National Assembly

APPENDIX A TO MINUTES

ACKNOWLEDGMENT RESOLUTIONS:

A-76-1 Appreciation to the President.
WHEREAS Alvin E. Rudisill, as president of the American Industrial Arts Association, has given so liberally of his time and his talents and has exhibited an outstanding capacity for leadership, and
WHEREAS the Association has made exemplary progress under his leadership,
BE IT HEREIN RECORDED that the Association, through its membership, officers and Executive Board, expresses its fullest appreciation to him.

A-76-2 Appreciation to the Conference Committee, the Program Committee and the Program and Conference Participants.
INASMUCH as the 38th Annual Conference of the American Industrial Arts Association was possible through the direct, dependable and efficient service of great numbers of members of the Association, and
INASMUCH as the conference has achieved an outstanding level of success,
BE IT HEREIN RECORDED that sincerest appreciations are expressed to Jim Bensen, program chairman, and Rich Saemisch and Ervin A. Dennis, general cochairmen, to the members of conference committees and to all the teachers, supervisors, teacher educators and students whose efforts in total produced this conference.

A-76-3 Appreciation to the SHIP.
INASMUCH as the continuing support for and the participation in the conduct of the 38th Annual Conference of the Association, and
IN VIEW of the excellence of this year's commercial exhibits as a feature of the conference,
BE IT HEREIN RECORDED that the American Industrial Arts Association expresses its appreciation to educational exhibitors for their participation in the 1976 Conference.

A-76-4 Appreciation to the Teacher Recognition Program.
INASMUCH as the Association is dedicated to encouraging excellence in teaching, and
INASMUCH as its program of recognition of outstanding teachers is marked with increasing excellence,
BE IT HEREIN RECORDED that expressions of appreciation are tendered to Frank Jackowski, vice president for Classroom Teachers, and his committee for their contribution in the conduct and promotion of this program,
BE IT ALSO RECORDED that appreciation is expressed to the officers and members of state associations who have participated in the teacher recognition program.

A-76-5 Appreciation to the Executive Board.
WHEREAS Herbert Bell, vice president for Industrial Arts Supervisors; Laura L. Lewis, vice president for Classroom Teachers; Louis G. Ecker, vice president for State Association Officers; Walter C. Brown, vice president for Teacher Educators; Wilbur R. Miller, vice president for Elementary School Industrial Arts; Gary R. Gunning, vice president for College Students; Lee Carter, president-elect; and Donald F. Hackett, immediate past president, have all given liberally of their time and talents in providing outstanding leadership and service, and,
WHEREAS the Association has made exemplary progress under the leadership of these Executive Board members,
BE IT HEREIN RECORDED that the Association expresses its fullest appreciation to them.

A-76-6 Appreciation to the Governor of the State of Iowa.
IN VIEW of his support for industrial arts and the 1976 AIAA Conference held in Des Moines, Iowa,
BE IT HEREIN RECORDED that the Association expresses its appreciation to Governor Robert D. Ray for his assistance in making this conference a success.

A-76-7 Appreciation to the Superintendent of Public Instruction.

BECAUSE the progress of industrial arts education within each state reflects the philosophy and efforts of the Chief School Officer, the Association expresses its appreciation to the Iowa superintendent of Public Instruction, Robert D. Benton, for his demonstrated support of industrial arts education and to this conference.

THIS APPRECIATION IS FURTHER EXTENDED to Harold Berryhill, consultant for Industrial Arts, for his cooperation toward this conference and for his achievements toward the improvement of industrial arts education in the great state of Iowa.

A-76-8 Appreciation to the Mayor of Des Moines.

FOR his assistance in selecting a site of the 1976 AIAA Conference and for his support of the conference,

BE IT RECOGNIZED in appreciation to Richard E. Olson, mayor of Des Moines, that he promoted and encouraged the success of the conference.

A-76-9 Appreciation to Personnel of the Iowa Industr. Arts Associations.

THE cooperation of Al Sherick, president, Iowa Industrial Education Association, and members of the association in preparation for and co-hosting the 38th Annual Industrial Arts Association Conference is recognized as a major factor in its success and the AIAA through its Executive Board and membership expresses its sincere appreciation.

A-76-10 Appreciation to Education Personnel.

THE success of the 38th Annual Conference rests in large measure on the devotion and contributions of the personnel of public schools and collegiate institutions. THE membership of the AIAA through its Executive Board and membership expresses thanks and appreciation for their contributions.

A-76-11 Appreciation to the Public Schools.

INASMUCH as the success of the 1976 Conference was insured by the fullest cooperation of Dwight D. Davis, superintendent of Des Moines Public Schools, and his staff,

BE IT HEREIN RECORDED that the officers and members of the American Industrial Arts Association express their gratitude for their assistance.

A-76-12 Appreciation to the National Office.

BECAUSE of the vital role of the national office of the Association in the effectiveness of the service to the Association and its members, appreciation by the membership and the Executive Board is herein expressed to the national office staff.

A WORD of special commendation is expressed for the work of Jim Dixon whose efforts over the past three years have done much to make the conferences successful.

A-76-13 Appreciation to Kenneth W. Brown and Margaret Brown

WHEREAS Kenneth W. Brown, former Association secretary-treasurer serving without remuneration from 1953 through 1961, organizer of the American Council of Industrial Arts Supervisors, outstanding classroom teacher, supervisor, university professor, division director, and author, has made an exemplary contribution in leadership and service to the Association as well as to the profession, and

WHEREAS his wife, Margaret Brown, gave unstintingly of her time and talent in maintaining the fledgling national office in her kitchen,

BE IT HEREIN RECORDED that the Association expresses its fullest appreciation to them at the time of his retirement.

APPENDIX B TO MINUTES

STANDING RESOLUTIONS:

S-76-1 THE AIAA believes that excellence in the classroom is the foundation of a good education system.

THE Association therefore supports the philosophy that only properly certified individuals be permitted to teach industrial arts.

THE Association further seeks the abolishment of all substandard teaching certificates currently being issued.

76-2 THE AIAA believes that an industrial arts program offers one of the best educational opportunities that can be used to help young people grow to the maximum of their individual abilities;
THEREFORE, the Association further believes that a program of industrial arts should be offered in all elementary, middle and secondary schools in all nations.

76-3 THE AIAA believes that program and institution accreditation assures the continued development of quality programs of education.
TO THIS END, the AIAA encourages its committees and member councils to formulate accreditation and/or to update standards for all programs of industrial arts conducted in elementary, middle and secondary schools, colleges and universities. The standards should be designed to promote improvement through self-evaluation as well as to provide criteria used by accreditation agencies.

76-4 THE AIAA believes that a maximum effort should be extended in soliciting membership for and continuing the development of the industrial arts student clubs at both the high school and college levels.

76-5 THE AIAA believes that all persons, regardless of race, creed, color or sex, should be given the opportunity to participate in the programs of industrial arts in the schools of all nations.

76-6 THE AIAA believes and continues to support the international movement to standardize and convert to the metric measurement system and encourages all of its members to include instruction on the metric system in their classes.

76-7 THE AIAA believes that all educators and all professional associations should work together in the education of the youth of our schools to better prepare them for an ever-changing technological society.

76-8 THE AIAA believes that a maximum effort should be extended in the business-industry-education partnership for the purposes of keeping that segment of the society informed of the contribution of industrial arts to the youth of all nations.

APPENDIX C TO MINUTES

CURRENT RESOLUTIONS:

C-76-1 Recognition of Congressional Support.
WHEREAS: The AIAA has the responsibility of working cooperatively with congressional leaders to ensure that federal legislative priorities reflect the needs of the approximate 8 million students enrolled in industrial arts programs under the supervision of approximately 60,000 industrial arts teachers, and
WHEREAS: The House and Senate educational subcommittees and staff have been most helpful and cooperative in incorporating AIAA recommendations into newly proposed educational legislation, and
WHEREAS: H.R. 12835 as introduced on March 29, 1976, contains language which is supportive of industrial arts and reflects the AIAA recommendations, be it therefore
RESOLVED: That the AIAA commend each member of the Senate and House educational subcommittees and their minority and majority counsels for their support of industrial arts programs in federal legislation, And be it further
RESOLVED: That the AIAA continue its efforts to ensure that the language related to industrial arts in H.R. 12835 as introduced on March 29, 1976, be retained in final legislation.

by Jim Good, New York, for the Legislative Committee

C-76-2 WHEREAS: The New York State Industrial Arts Association has actively supported an ongoing membership promotion for AIAA since its affiliation in 1966, and
WHEREAS: It is believed that all state level affiliated organizations representing industrial arts education provide similar AIAA membership promotion services; therefore be it

RESOLVED: That the 1976-77 AIAA Executive Board recommend to the 1977 House of Delegates an AIAA membership dues incentive plan.

by Thomas D. LaClair, New York

C-76-3 WHEREAS: In 1974-74 a representative committee of 80 American Industrial Arts Association members was appointed for the purpose of making recommendations for the revision of the AIAA constitution, and

WHEREAS: At the Seattle Conference a recommendeconstitution was presented by said committee to the Executive Board of the American Industrial Arts Association, and

WHEREAS: At the Cincinnati Conference two separate hearings were held on said proposed constitutional revisions and subsequently reported to the American Industrial Arts Association Delegate Assembly and the Executive Board, and

WHEREAS: The proposed constitution was further reviewed and refined both by legal counsel and by the AIAA Executive Board, and

WHEREAS: Said proposed revised constitution was submitted in March of 1976 by mail ballot to the membership of the American Industrial Arts Association for the purpose of obtaining a vote of the membership, and

WHEREAS: The membership voted to adopt said revised constitution, be it therefore

RESOLVED: That all members of AIAA now join together in supporting the provisions of the new constitution.

by Larry ~~Wright,~~ Wisconsin

C-76-4 WHEREAS: The annual conference should be supported by those attending the conference, and

WHEREAS: The planning costs to provide a conference exceed the monies presently extended by the Association as preplanning monies, and

WHEREAS: The planning of a conference should not be a financial liability to the state or states hosting the conference, and

WHEREAS: The monies generated by the conference are the primary resources which support the activities of the Association, be it therefore

RESOLVED: That the preplanning monies provided, by the Association to the conference planning committee, be 4,000 dollars, and be if further

RESOLVED: That the conference registration fee for each regular member include the amount of 5 dollars which shall be returned to the Planning Committee to meet obligations incurred prior to and during the annual conference, and be it further

RESOLVED: That any expenses which exceed the total monies provided by this resolution shall be an obligation of the Conference Planning Committee unless given special consideration by the AIAA Executive Board, and be it further

RESOLVED: That all monies remaining after the Planning Committee's obligations are met shall be returned to the treasurer of the AIAA, and be it further

RESOLVED: That the financial chairman of the Planning Committee shall provide the president of the AIAA a line item report listing all income and expenditures of funds resulting from the conference planning committee's activities.

by Carl York, Illinois

C-76-5 WHEREAS: The cost of services has increased in all areas of the economy, and,

WHEREAS: The AIAA membership dues have not been increased to keep pace with these increased costs, be it therefore

RESOLVED: That the Executive Board consider the practicality of increasing the dues for regular members, over a period of five years, to an amount not to exceed 50 dollars.

by Allen Bame, Virginia

C-76-6 WHEREAS: There is but one AIAA Representative National Assembly Annual Business Meeting a year, and

WHEREAS: The delegates to that Assembly represent the AIAA membership, and

WHEREAS: The AIAA is responsible to its members, and

WHEREAS: Neither the Delegates nor the membership have prior knowledge of the items to be presented at the annual business meeting, and

WHEREAS: There are no means for the membership to provide input to the delegates before that meeting, and

WHEREAS: Prior knowledge of business items is important for rational decision-making, and

WHEREAS: It is realized that better communications within an organization improves that organization, therefore be it

RESOLVED: That the AIAA Executive Board supply to affiliated state associations, at least one month in advance of the annual business meeting, those business items which are to be acted upon by the Representative National Assembly.

by Jerry Hardy, Virginia

C-76-7 WHEREAS: Membership in AIAA is less than 10 percent of the total number of industrial arts teachers in the United States and Canada, and

WHEREAS: Past membership drives have been ineffective, therefore be it

RESOLVED: That a one-year complimentary membership be given to all graduating teachers with a major or minor in industrial arts who apply in writing to the national office verifying their first year teaching assignment and supplying proof of membership in their respective State Industrial Arts Education Associations.

by Louis J. Pardini, Arizona

C-76-8 WHEREAS one of the distinguishing marks of a professional association is the internal awareness of the need for a constant evaluation of the purposes by which it was founded, and

WHEREAS this need stems from an expressed concern by the organizational membership who recognize that the interest and growth of a professional association can only be achieved with the goals, purposes and specific responsibilities are constantly monitored, and

WHEREAS, each individual involved in a professional association must willingly accept this examination of purposes as an organizational necessity and professional responsibility, be it therefore

RESOLVED, that the AIAA Research Committee be provided the authority to initiate an international study to review and update the goals, purposes and responsibilities of AIAA to the profession.

by Everett N. Israel, Massachusetts

Teacher Recognition Program

During the 1976 International Conference of the American Industrial Arts Association in Des Moines, Iowa, the Teacher Recognition Committee met with each of the 47 recipients of the Outstanding Industrial Arts Teacher of the Year award and presented him/her with a ribbon of distinction to be worn while attending the conference.

The following teachers received the award:

Bernadean Showers, Alabama; John S. Adams, Arizona; Richard M. Little, California; John E. Fisher, Colorado; John A. Ringrose, Connecticut; William R. Simpson, Delaware; Denis R. Binder, Florida; Coleman Peacock, Georgia; Kenichi Higa, Hawaii; John R. Murphey, Idaho; Victor Bell, Illinois; Richard B. Clausen, Indiana; Theodore O. Nunemaker, Iowa; Joe B. Spence, Kansas; John S. VanHoose, Kentucky.

Isaiah S. Chambers, Jr., Louisiana; John R. Schuma, Maryland; Clifford Feindel, Massachusetts; John P. Takis, Michigan; Edward S. Barski, Minnesota; Larry S. Anderson, Mississippi; Fred Baum, Missouri; H. Robert Armagost, Nebraska; Eston L. Simms, Nevada; Charles R. Hothem, New Jersey; William V. Nelson, New Mexico; Robert N. Jones, New York; Russell W. Barrett, North Carolina; George J. Kovash, North Dakota.

William E. King, Ohio; R. L. Quinton, Oklahoma; Charles R. Easley, Oregon; Paul E. Matter, Pennsylvania; Thayer N. Donovan, Rhode Island; Dennis A. Schnabel, South Dakota; Samuel Ballard, Tennessee; David P. Lorms, Texas; Gary O. Singleton, Utah; James W. Brown, Vermont; Michael B. Gallimore, Virgiina; Paul H. Johnson, Washington; Starling C. Reed, West Virginia; Robert Duren, Wisconsin; Walter J. Wieland, Wyoming; Paul B. Butler, New Brunswick, Canada; George F. Burgin, Ontario, Canada; Allan Stewart, Nova Scotia, Canada.

The President's Report, 1975-1976

Alvin E. Rudisill

THE YEAR OF REORGANIZATION

Most of the efforts of the national office staff and the Executive Board this past year have been directed toward reorgzniaing and updating Association policies and procedures and improving the processing of membership records. The reorganization began with the Association constitution and continued through the new Policies and Procedures manual for the House of Delegates. Association membership records have been computerized, and we should now be able to eliminate many of the problems in this area that have plagued the national office staff over the past several years.

The year for your president has been professionally and personally rewarding, and I shall long remember the people, places, ideas and enthusiasm I came in contact with as I traveled throughout the United States representing the Association. I extend my thanks and appreciation for placing your confidence in me and for the enthusiastic support I have received from every component of our Association.

THE AIAA EXECUTIVE DIRECTOR

This past year our new executive director, Donald Rathbun, has made many changes in national office procedures and practices that have and will continue to improve services to members. In addition, he has assembled a team of national office personnel that have and will continue to improve communications throughout the Association.

One of the major efforts this past year of our executive director and our Legislative Committee under the direction of James Good was to insure that industrial arts education receives appropriate consideration in new national legislation. Their efforts have resulted in our Association becoming an effective and powerful national lobbying force with a national network of personnel. These efforts should result in improved funding for industrial arts in the coming years.

Our Executive Board is confident that the services provided our membership through the AIAA national office will continue to improve and expand under the competent and enthusiastic leadership of Mr. Rathbun.

THE AIAA EXECUTIVE BOARD

The Executive Board of the Association consists of the following:

Alvin E. Rudisill, president
Donald F. Hackett, past president
Lee D. Carter, president-elect
Francis J. Cackowski, vice president for Classroom Teachers
Laura L. Lewis, vice president for Classroom Teachers
Walter C. Brown, vice president for Teacher Educators
Herbert Y. Bell, vice president for Supervisors
Wil Miller, vice president for Elementary School Industrial Arts
Lou G. Ecker, vice president for State Association Officers
Gary Gunning, vice president for College Students
Donald L. Rathbun, executive director

The Executive Board met three times during the past year and complete minutes are included in the delegate packet. Some of the items discussed at each meeting were as follows:

A. Meeting of March 27, 1975 — Cincinnati, Ohio
1. Crossroads '76 items
2. 1975-76 budget adjustments
3. National office staff leave policy
4. Administrative Committee handbook
5. Constitution revision procedures
6. House of Delegates resolutions
7. AIAA State Representatives — Policies and Procedures

8. AIAA committee items
9. State Association affiliation procedures
10. Conference site selection
11. Cincinnati Conference report
12. NEA affiliation
13. AIAA Foundation
14. Council reports

B. Meeting of January 26, 27 and 28, 1976 — Tempe, Arizona
1. Membership promotion and processing
2. Life membership reserve study
3. Sale of AIAA membership lists
4. AIACSA items
5. AIAA dues collection by affiliated organization
6. Insurance programs
7. Financial status report
8. Advertising in AIAA publications
9. "History of Industrial Arts" slide project
10. Constitution revision
11. Committee activities
12. 1976-77 committee handbook approved
13. Conference proposal guidelines approved
14. Conference complimentary room policy
15. Council reports
16. Association travel expense policies
17. Crossroads '76 items
18. AIAA publications editor report
19. AIAA coordinator of professional services report

C. Meeting of April 18 and 19, 1976 — Des Moines, Iowa
1. Report on constitution ballot
2. Life membership survey
3. Wisconsin State and Alabama State Association affiliation
4. Special citation ballot
5. House of Delegates Policies and Procedures Manual
6. Membership report
7. 1975-76 budget status report
8. 1976-77 budget
9. State Association affiliation procedures
10. Report on committee activities
11. NEA affiliation status
12. Joint conference proposal report
13. Conference guidelines
14. Research Committee report
15. Resolutions
16. Council reports

THE AIAA ADMINISTRATIVE COMMITTEE

The AIAA Administrative Committee consists of the president, president-elect and immediate past president. The committee is responsible for directing and supervising national office operations and met in Washington, D.C., on September 8, 9 and 10, 1975. A detailed report of the topics discussed and actions taken at this meeting is included in your packet.

THE AIAA CONSTITUTION

The new constitution of the American Industrial Arts Association has been approved by a mail vote of the membership and will become effective July 1, 1976. The new constitution is the product of a three-year effort by an 80-member Constitution Revision Committee under the direction of Larry Wright and the Executive Board. It is an excellent

document that should serve the Association for many years, but at the same time provides for an amendment procedure which can be activated as the need arises.

COMMITTEE ACTIVITIES

The committees of the Association have been very active this past year under the capable and effective leadership of President-elect Lee Carter. A detailed report of these activities is included in this packet. One of the most effective devices utilized for improving communications in the Association this past year was the Committeegram which was edited by Lee Carter. It is the intention of the incoming president-elect, Billy Mayes, to continue this form of communication during the forthcoming year.

MEMBERSHIP

Membership in the Association increased significantly during this past year and future membership growth potential is excellent. The executive director and Membership Committee under the direction of Myron Bender are currently finalizing plans for an even more extensive membership drive next year.

RESOLUTIONS OF THE 1975 REPRESENTATIVE ASSEMBLY

The Executive Board took the following actions in regard to current resolutions passed at the 1975 Representative Assembly:

C-75-1: Constitution. The constitution was referred to the president for review and the Executive Board revised and approved the document at the January 1976 Board meeting. It was subsequently passed by the membership ballot.

C-75-2: Metrication. This resolution was referred to the AIAA Publications Committee and the AIAA editor for implementation.

C-75-3: Eliminating sex discrimination in Industrial Arts. This resolution was published in AIAA publications which were distributed to membership throughout the U.S.

C-75-4: Industrial Arts Clubs. This resolution was referred to Jim Dixon, AIAA coordinator of professional services, for the development of appropriate materials for teacher education programs.

C-75-5: Legislation. This resolution was referred to the AIAA Legislative Committee for implementation.

GOALS FOR COMING YEAR

It has been the policy for several years for the current president to establish Association goals for the coming year. However, I believe that the achievement of projected goals will be more fully realized if the president-elect establishes those goals since his leadership will guide this Association beginning at the close of this conference. Therefore, President-elect Lee Carter will present these Association goals to the House of Delegates.

IN CONCLUSION

It has been a very good year. The Association has grown in number of members and I believe in the quality of its services and leadership influence. Your president has also grown because of his involvement with the thousands of dedicated individuals who make this Association work.

Author Index